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THE NEW ORLEANS EXPOSITION.

THE main exhibition building, which it was at first supposed would cover all requirements, is of the enormous size of 1,378 by 905 feet, or embracing an area of 33 acres, while the area of the main building at the Philadelphia Exposition of 1876 was only 20 acres. In this New Orleans building there are no partitions, and the interior is surrounded by wide galleries, 23 feet high, supported by the pillars which also support the roof, the latter being mostly of glass. The machinery department occupies a space 300 feet wide for the whole length of the main building, but this has been found insufficient, and large extensions have been made necessary by the great number of applications for space in this section. In the center of the main building is the Music Hall, with chairs enough to accommodate 11,000 people, a platform for 600 musicians, a mammoth organ, etc.

A special building for United States and State exhibits is 885 by 565 feet in size. Congress, besides loaning the management $1,000,000 to forward the enterprise, has made liberal appropriations for a most thorough representation of the leading departments of the government. The department of State will show here samples of cotton, wool, and other fibers, and their products, from all parts of the world. The Post Office department will show all the modern improved facilities in this branch of the public service, besides having working offices on the grounds. The Treasury will exhibit the work of the coast survey, lighthouse, and customs service, engraving, printing, etc. The War Office will make an imposing display of arms, ordnance, engineering, medical, surgical, and hospital service; while the Navy, the Interior, and other departments will all be more fully represented than they ever were before at one exhibition. Collective State exhibits and a general educational display will also be located in this building.

Horticultural Hall, 600 x 194 feet, has been substantially built as a durable structure to subsequently become the property of the city of New Orleans. It has a tower 90 feet high, roofed with glass, beneath which will be a grand fountain in constant play.

Around this hall will be arranged a great variety of rare tropical and semi-tropical plants, flowers, and shrubbery. Cash premiums to the amount of $32,000 are offered in this department, and the contributions thereto will be largely from Mexico, Central America, and the West Indies.

The Art Gallery, 250 by 100 feet, is an iron building, calculated for permanent use for such purpose, in its arrangements for mounting pictures, giving them the desired light, etc.

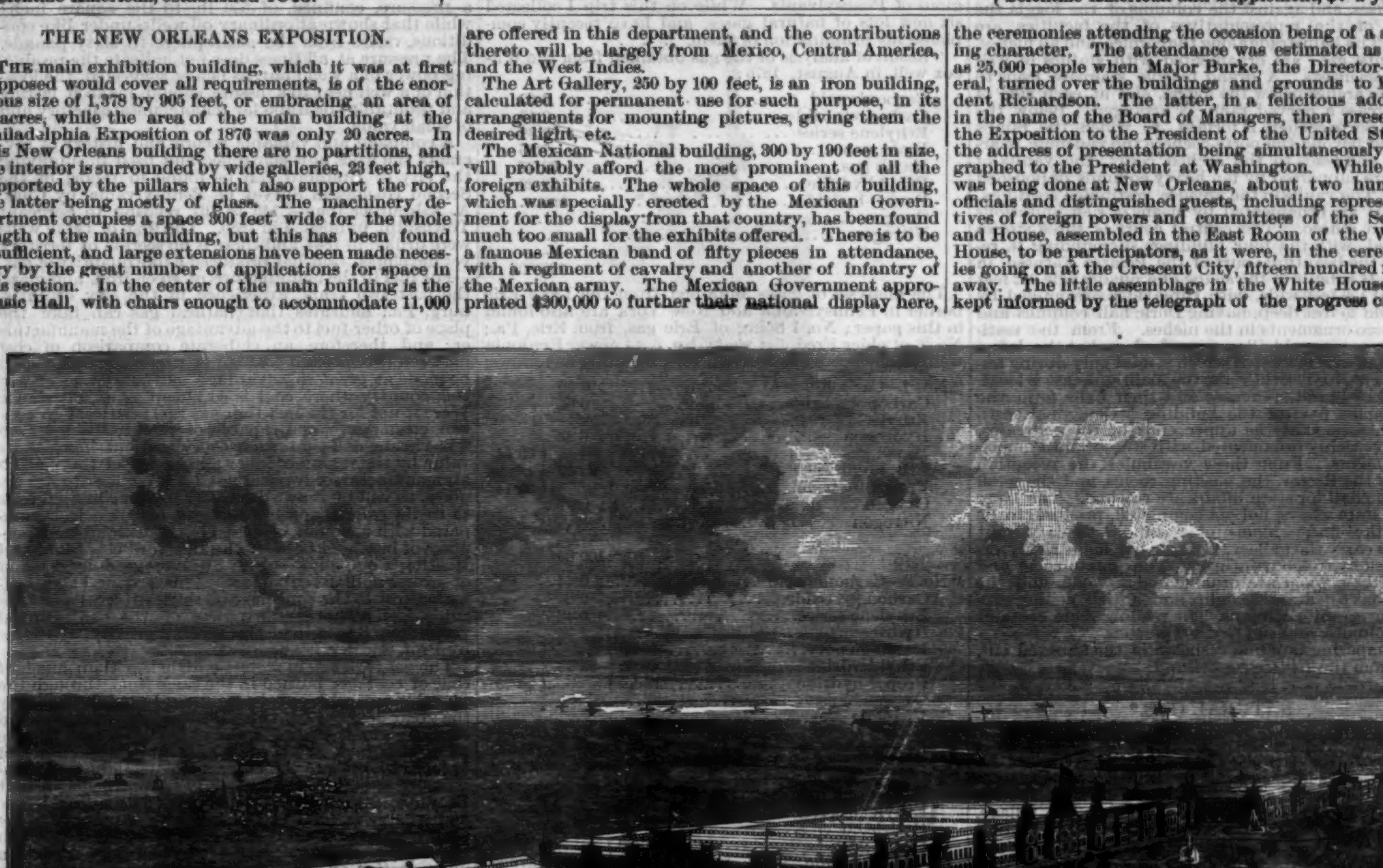
The Mexican National building, 300 by 190 feet in size, will probably afford the most prominent of all the foreign exhibits. The whole space of this building, which was specially erected by the Mexican Government for the display from that country, has been found much too small for the exhibits offered. There is to be a famous Mexican band of fifty pieces in attendance, with a regiment of cavalry and another of infantry of the Mexican army. The Mexican Government appropriated $200,000 to further their national display here, and General Diaz, the Mexican President, announced his intention of being present at the inauguration ceremonies.

Besides the buildings above mentioned, there are several others, for individual exhibits, or as additions to those at first found too small for their original purposes.

The different groupings of exhibits, under which all articles wrought by man or produced by nature are classified, is as follows: 1, Agriculture. 2, Horticulture. 3, Pisciculture. 4, Ores and Minerals. 5, Raw and Manufactured Products. 6, Furniture and Accessories. 7, Textile Fabrics, Clothing, and Accessories. 8, The Industrial Arts. 9, Alimentary Products. 10, Education and Instruction. 11, Works of Art.

The grounds on which the exposition is to be held consist of 247 acres, known as the City Park, about four miles from the business center of the city and with a frontage of about half a mile on the Mississippi River, affording ready landing for steamers, besides excellent rail facilities. The temperature of New Orleans from the 1st of December to the last of May averages about 65° F., the thermometer seldom falling below freezing point, while the fields and forests retain their foliage, and nature presents a most attractive appearance to one visiting the city from the harsher clime of a northern latitude.

On December 16, 1884, the great World's Industrial and Cotton Centennial Exposition was formally opened, the ceremonies attending the occasion being of a striking character. The attendance was estimated as high as 25,000 people when Major Burke, the Director-General, turned over the buildings and grounds to President Richardson. The latter, in a felicitous address, in the name of the Board of Managers, then presented the Exposition to the President of the United States, the address of presentation being simultaneously telegraphed to the President at Washington. While this was being done at New Orleans, about two hundred officials and distinguished guests, including representatives of foreign powers and committees of the Senate and House, assembled in the East Room of the White House, to be participators, as it were, in the ceremonies going on at the Crescent City, fifteen hundred miles away. The little assemblage in the White House was kept informed by the telegraph of the progress of the exercises at New Orleans; and at 2:45 P. M., when President Richardson's address of presentation was thus received, President Arthur made an appropriate speech in reply—which was likewise simultaneously telegraphed to New Orleans—congratulating the promoters, and officially declaring the exposition open. At the conclusion of his address, President Arthur touched a key at the table before him, ringing a little electric bell near the great engine in the exposition, which was the signal for the engineer in charge to turn the throttle valve and let on the steam. A cheer followed the tinkle, then the 27 foot fly wheel of the 650 horse power Harris-Corliss engine began to move, with the long lines of shafting; but the big wheel had scarcely made a revolution before four other engines were started, and began to work in unison, and the exposition was in fact actually under way.



BIRD'S EYE VIEW OF THE GREAT EXHIBITION BUILDINGS AND GROUNDS, NEW ORLEANS, LA.

AN examination of a series of water marks set in 1750 all round the Swedish coasts, from the mouth of the Tornea to the Naze, in order to settle a dispute between the Swedish astronomer Celsius and some Germans as to whether the level of the Baltic has been rising or sinking, shows that both parties were right. The gauges were renewed in 1851, and again last year, and have been inspected regularly at short intervals. It appears that the Swedish coast has been steadily rising, while that on the southern fringe of the Baltic has been as steadily falling.

THE NEW UNIVERSITY BUILDINGS AT VIENNA.

THE University of Vienna was founded in 1365 by the Emperor Rudolph; and on October 11 of this year the celebration of the completion of the new buildings began. These new buildings were designed by the well known architect Heinrich von Ferstel, who did not live to see them completed. His work was carried on after his death by his son, Baron Max von Ferstel, and the architect Karl Koechlin.

Ground was broken in 1873 between the Parade Ground and the Votive Church Square on the Ring Strasse. The style of the building is the purest and most noble Renaissance. The central pavilion is surmounted by a dome, and contains the halls for state affairs. In the tympanum of the loggia a group is placed representing Zeus and Pallas Athene with the nine Muses, and against the columns of the loggia the statues of the representatives of the faculties are placed. The balustrade along the cornice, and all niches, pediments, etc., are ornamented with statues of well known scientists. A grand marble staircase leads to the three arches below the loggia, and at each side of the staircase a curved ramp is arranged. Below the loggia a porte-cochere is formed, to which the ramps lead, and beyond the porte-cochere the vestibule is arranged, and leads to the arched court, the vaults of which are supported by ten heavy columns of polished granite. The vaults in the arcades, vestibules, corridors, and halls are ornamented by means of rich imitations of Italian stucco. The central court is three stories high, and, with the four buildings surrounding it, resembles the beautiful court of the Palazzo Farnese in Rome. It is built in the shape of a quadrangle 212 feet long and 150 feet wide, with three sides surrounded by an arcade 25 feet deep, having Doric half columns and rich stucco ornaments in the niches. From the vestibule two octagonal halls are reached, and at the left a grand staircase is located which is used only during festivities, etc., and at the right the main staircase is located. These grand staircases and their halls form the most elegant part of the building. Octagonal vestibules are formed at the upper ends of the staircases, which are richly ornamented with stucco and Pompeian ornaments. From these vestibules the reception rooms of the Rector, the meeting rooms, and the small and large hall for state affairs are reached. The large hall for state affairs, not yet completed, promises to be one of the finest rooms of its kind. Twenty-eight columns carry the gallery, forming five fields richly ornamented by fresco paintings. The senate room and the Rector's room are ornamented in wood, and the library has top and side lights and a rich ceiling supported by granite columns. The reading room contains 60,000 volumes, and can seat 400 persons.

This imposing building is shown in the annexed cut, taken from the *Illustrirte Zeitung*.

NATURAL GAS.*

By C. E. HEQUEMBOURG, of Bradford, Pa.

NATURAL gas attracted attention as an agent for illumination as long ago as 1821, when a gas spring or well was discovered at Fredonia, N. Y., within a rod of the old State road that passes through the village. The spring, as then, is now located in the slate rock that forms the bank of the Canadaway Creek. Gas was collected by excavating and covering the spring, conveyed into a small copper holder, and from thence conducted through pipe to a mill and several stores for illumination. To Mr. Elias Forbes, of Fredonia, I have been for many years indebted concerning information given regarding this gas; and he now vouches for the accuracy of the following statement obtained from a history of Chautauqua County:

"The use of natural gas at Fredonia was begun in 1821, when experiments were made to determine its illuminating value, and it was introduced into a few of the public places, among which was the hotel that then occupied the site of the Taylor House, and which was thus illuminated when Lafayette passed through the village in 1824. The gas so used at that time was the first used in the United States, and the gas works established here were the first in this country. The spring first discovered, and from which gas was first used, is located on the north bank of the Canadaway Creek, at the bridge crossing the stream on Main Street, in the village of Fredonia. The gas escaped in various places in the immediate vicinity; but when the well was sunk it was all drawn to it. The gas from this well, which was sufficient for thirty burners, was used alone till 1858, when another was sunk on the creek in the northwest part of the village, by Preston Barmore, the shaft being thirty feet deep, six feet in diameter at the top, and fourteen feet at the bottom, with two vertical borings, one of 100 and the other of 150 feet depth. In the fall of 1858 Elias Forbes, the present president of the gas company, purchased a half interest in the well, and that fall a company was formed, and during the remainder of that and the following year the gas, in sufficient quantity to supply about 2,000 cubic feet per day, was conducted to the village through three miles of mains, and supplied directly from the well to the stores of the village. During the latter year (1859) the company put in a gas receiver or holder of 12,000 cubic feet capacity, and supplied private houses. In the fall of 1871 Alvah Colburn made a boring for gas near his mill, with a view to supplying fuel for generating steam therefor; but the supply was inadequate for that purpose, though it was evolved in considerable quantity. He therefore purchased the Barmore interest in the gas company, and connected his well, which is 1,200 feet deep, with the company's receiver; since which time the supply of gas has been ample for the demands of the village. Previous to the opening of Colburn's well the supply of gas was not sufficient to meet the demands for it during the winter, and the deficiency was made up by gas manufactured from coal. Prof. Hoadley's experiments show that the consumption of natural gas as compared with that manufactured from coal, through burners of equal capacity, and in equal times, is less than one-half, with a greater candle power. He shows that a burner which consumed six feet of coal gas in one hour, with an illuminating power equal to fourteen sperm candles, six to the pound, consumed of the natural gas a fraction less than three feet, with an illuminating power of a little more than sixteen sperm candles. The natural gas also possesses a greater diffusive power, and one who has been accustomed to the use of coal gas, finding it difficult to read ordinary print without being in close proximity to the light, is astonished at the facility with which he can read in any part of an ordinary-sized dwelling room under the light from the natural gas."

For an analysis of this gas, and that of other gases, especially that obtained from the Wilcox well in Sergeant Township, McKean County, Pa., from which, and others near by, the city of Bradford obtains its present supply, I copy from the paper of Prof. Samuel P. Sadtler, read before the American Philosophical Society, March 2, 1877: "During the past summer (1876) I was again employed in the service of the Second Geological Survey of the State, and spent a month in the oil regions of Pennsylvania. While on this trip I collected six new lots of natural gases, and have recently completed my examination of them. . . .

"Result of analysis of the gas obtained from the Wilcox well, in August, 1876:

Carbonic acid	0·02
Carbonous oxide	0·15
Ethylene series	0·62
Hydrogen	7·55
Marsh gas	62·37
Ethyl-hydride	29·29
Propyl-hydride	trace.
Oxygen	....
Nitrogen	....
	100·00"

The analyses of gases obtained from the Lake Erie border in Pennsylvania and New York are also found in this paper; No. 1 being of Erie gas, from Erie, Pa.; No. 2, of older Fredonia well; No. 3, of newer Fredonia well, and collected in August, 1876, resulting as follows:

"No. 1—Carbonic acid		0·30	
Carbonous oxide		0·61	
Ethylene series		....	
Hydrogen		0·43	
Marsh gas	40·33	98·59	69·44
Ethyl-hydride	58·26		trace.
Propyl-hydride	trace.		29·15
Oxygen		0·07	
Nitrogen		....	
		100·00	

"No. 2—Carbonic acid		0·44	
Carbonous oxide		0·84	
Ethylene series		0·42	
Hydrogen		8·56	
Marsh gas	40·83	89·73	65·28
Ethyl-hydride	48·90		trace.
Propyl-hydride	trace.		24·25
Oxygen		....	
Nitrogen		....	
		99·99	

"No. 3—Carbonic acid		0·28	
Carbonous oxide		0·22	
Ethylene series		0·47	
Hydrogen		7·49	
Marsh gas	26·99	91·55	59·27
Ethyl-hydride	64·56		trace.
Propyl-hydride	trace.		32·28
Oxygen		....	
Nitrogen		....	
		100·01	

"The hydrocarbons of the marsh gas series in these three analyses can be counted together with perfect accuracy, as 98·59, 89·73, and 91·55 per cent. respectively; or we have a choice of two methods of reckoning the individual amounts, with proximate accuracy, however, only. In these analyses the second method of estimation, viz., that of dividing the amount between marsh gas and propyl-hydride, appears the more probable. A casual examination of these figures, with a reference to the approximate geological horizon in each case, will show several well-marked peculiarities.

"The gas from the McKean County geological horizon, obtained at the Wilcox well, is distinctly different from any of those preceding it. The 29·29 per cent. ethyl-hydride makes it a heavier gas. The three gases from the Lake Erie border, however, show the greatest differences. The per cent. of the ethyl-hydride exceeds the per cent. of marsh gas, so that it becomes reasonable to estimate some of these heavy hydrocarbons as propyl-hydride. These three gases would be the heaviest of all those examined. An experimental determination of the specific gravity of the Erie gas, made by the diffusive method, gave 804; the specific gravity as calculated from the analysis was 845."

After gas was found at Fredonia, such discoveries from year to year became more common. Judge Campbell, of Westfield, N. Y., by contract with the U. S. Government, lit (until abandoned about the year 1856) the lighthouse at Barcelona (a small harbor on Lake Erie) from a spring of natural gas.

In 1827 a contract was made by Walter Smith, of Dunkirk, N. Y., with the Government to light the lighthouse at that place for a term of years, and ½ inch lead pipe was laid 2½ miles from the Matteson gas spring at Fredonia; but, owing to the size of the pipe, no flow was obtained, and after many trials of other means of transportation the enterprise was abandoned. With the discovery of oil at Titusville Pa., in 1858-59, the many borings yielded more or less gas, and the first public notice taken of it in quantity was the burning of the Rouse well, in Oil Creek, where a large number of persons lost their lives by the explosion of gas, it having been fired from a lighted cigar. As strange as it may seem, this gas was then considered more of a nuisance than an article of value, and but little was used as fuel—it was mostly led from the wells in pipes, and burned so as to dispose of it. Any one who passed through Petroleum Center in 1869, when the oil development of McCray Hill was in its prime, cannot fail to remember this great waste of valuable fuel.

With the improved methods of dry drilling, gas has been more easily found and controlled; and although natural gas in late years has been found outside of the oil regions, where there was even no indication of oil, such facts only tend to strengthen some of the theories advanced regarding its origin. The most reasonable is that gas is found in the sand rock or oil sand only, as is salt water; and that its presence there is owing to fracture of the rock below. All gas wells of great volume are supposed to be fissure wells—the gas being generated in the carbonaceous shale hundreds of feet below any of the oil producing sands. That this is reasonable may be concluded from the fact that the largest wells do not at all times fill up the adjoining sand rock, but only the faults or extreme edges; and it is a known fact that in sand rock where there is the most oil the gas is lightest, and where there is little oil the gas is strongest.

As an illustration of the volume or pressure of gas, the wells used for the supply of the city of Bradford, located in Sergeant Township, Pa., are showing a pressure, confined, of 550 lb. to the square inch; while that shown at ordinary oil wells, under like conditions, varies from the atmosphere to sixty pounds. The pressure at all times does not indicate the producing power of a well; but, as before suggested, the location of a well near to a fissure should make it lasting and profitable; or if too far remote, unsatisfactory and of small value.

A complete and valuable record and history of several of the wells now controlled and used in supplying the city of Bradford can be found in report of the Second Geological Survey of Pennsylvania, by Chas. A. Ashburner (pages 146 to 167, relating to Sergeant Township), published in 1880. The first of these wells were drilled in 1864, and there is no section of territory yet developed that has produced a like quantity of gas.

For fuel in the manufacture of steel, iron, and glass, the past two years' experience in the city of Pittsburg, Pa., indicates that natural gas can take the place of other fuel to the advantage of the manufacturer; and, therefore, an elaborate comparison of cost between this gas and coal is not necessary, and would be made at great disadvantage, as there is no city in this country where coal is so cheap as at Pittsburg. Were it not for the fact that gas fuel is so easy to control, clean, pure, and capable of raising the most intense heats, and that such considerations increase its value by the saving of labor and saving of the materials manufactured, it could not be used for these purposes, as will be shown hereafter by some limited tests as to its caloric power expressed in cubic feet, compared with a pound of coal, etc. For combined purposes of heat and light, "The Bradford Gas Light and Heating Company" supply an average daily demand of several millions cubic feet. This is done at an estimated cost to the consumer of thirteen cents per 1,000 cubic feet. The candle power of the gas supplied varies from 8 to 24, and the specific gravity, as shown by Prof. Sadtler, is about 804.

The gas registers in meters a little less than one-half that of coal gas, burned in the same time, through the same burner, with equal pressure. In order to supply the great demand for this gas the company own and control eight thousand acres of gas land, twenty-nine miles of 8 inch, seven miles of 6, and several miles of 5⅝ inch, 3 inch, and 2 inch cast and wrought iron high-pressure conduits, that carry gas from fields distant Bradford two, twelve, and twenty-five miles. These mains carry variable pressure of 50 to 160 pounds to the square inch; and in order to increase the flow through these pipes during extreme weather, they operate a pump station of 580 horse power to compress, and by this additional pressure and acceleration of volume, increase the flow. Results of many average tests show:

1st—Compared with coal gas, natural gas exceeds it in caloric value 33⅓ per cent.

2d—With crude, ordinary, and best methods for combustion, the caloric value of natural gas, compared with coal under best conditions, is—

With crude method	20	cubic feet	= 1 lb. coal.
" ordinary "	11·29	" "	= 1 "
" best "	8·92	" "	= 1 "

3d—The value of 1,000 cubic feet of natural gas, under conditions below, compared with coal at $1.00 per ton of 2,000 lb.:

With crude method of carbonization	0·0250	per 1,000.
" ordinary " "	0·0443	"
" best " "	0·0635	"

Discussion.

Mr. M. S. Greenough—I would like to ask Mr. Hequembourg if I understood him to say that the pressure under which the gas issued from the well varied from 50 to 60 pounds; and also if I understood him to state that the candle power varied from 8 to 24.

Mr. C. E. Hequembourg—I stated that the confined gas from our well at Bradford maintained a pressure of 550 pounds to the square inch. The ordinary pressure of the gas from the other borings in the Bradford region (these borings having been put down principally for oil) varied from atmospheric pressure to 60 pounds to the square inch; and usually, when confined, they seldom exceed 52½ pounds to the square inch. I stated that the illuminating value of the natural gas used in Bradford varied, under different conditions, from 8 to 24 candles. The reason for this, as I understand it, is that there appears to be no method of burning natural gas satisfactorily except through the Argand burner. With an Argand burner rated to a consumption of 5 feet per hour, the photometric tests which have been made indicate 24 candle power; but under unfavorable conditions, or with burners that are not adapted to consume the gas properly, the candle power is very limited.

The depth at which the vein is tapped varies with the locality; but it is usually pierced at about sea level through the country, which, in our vicinity, would be at a depth anywhere from 1,000 to 2,500 feet.

We do not find purification to be necessary. You will notice that the analysis contains no mention of sulphureted hydrogen.

Twenty cubic feet of the gas equals one pound of coal.

Mr. McElroy—I have never carefully tested for illuminating value any of the natural gases excepting the Olean district product. I have, however, discovered that the Olean manufacturers place their computations on the basis that 22,000 feet of natural gas equals the calorific power of one ton of coal. It is sold to the blast furnace proprietors on that basis.

Mr. Hequembourg—We have made very careful tests

* A paper read at the meeting of the American Gas Light Association at Washington, D. C., Oct. 15, 1884.

of the calorific power of the Bradford gas—first, by measuring the number of cubic feet per pound that it required, under ordinary conditions, to evaporate a certain number of pounds of water. I took a boiler 14 feet in length, 62 inches in diameter, and having 96 three-inch flues. It was set in an ordinary arch. With this boiler I made a number of six-hour tests, using gas for fuel, under all sorts of conditions, and then reversed the firing conditions by substituting coal—care being taken to make the tests identical as to time, etc. We found that as a result we could evaporate about 8·55 pounds of water to the pound of coal. On the other hand we proved, taking the results ensuing from the best conditions of gas firing, that 7·95 cubic feet of the gas would evaporate a pound of water.

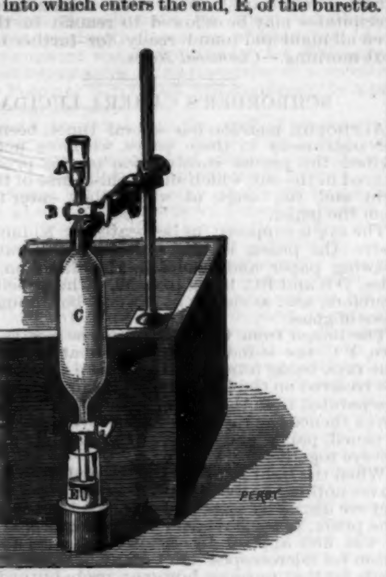
Mr. McElroy—Mr. Young and myself also went through a series of experiments on this question. The natural gas tested came from the Butler County district. We tried all the various methods of evaporation. In our test-boilers we evaporated 9·5 pounds of water to the pound of Pittsburg coal; and the outcome of the tests went to show that the calorific effect of the ton of Pittsburg coal equaled that resulting from a consumption of 22,000 feet of Butler gas. An approximate result was obtained in heating an iron puddling furnace. We weighed our coal and measured our gas. We ran day and day about, alternating in the same furnace, and continued the experiments for about six weeks.

APPARATUS FOR ESTIMATING THE OXYGEN DISSOLVED IN WATER.

THE accompanying engraving, which we borrow from the *Annuaire de Montsouris*, represents an apparatus for estimating the quantity of oxygen dissolved in water. The water to be examined is taken directly from the source or from the pail in which it has been drawn from the well. We should state here that we are not making theoretical studies; we take water such as we drink. This water is placed in a glass bottle holding about a liter, and having a glass stopper. The bottle is entirely filled, so that when the stopper is introduced it shall drive out the excess of water without leaving any air bubbles. In this state it is carried as quickly as possible to the burette, C, which has a capacity of about 100 cubic centimeters. It is then uncorked and its stopper replaced by one of rubber which is traversed by two small glass tubes, one of which, *a*, descends to the bottom, and the other, *b*, reaches only to the top. The burette, C, is taken from its support, its two glass cocks, B and D, are opened, the extremity, E, is introduced into a piece of rubber tubing, which is adjusted to the external end of the tube, *a*, of the bottle, and then, either the mouth or the extremity of a rubber bulb being applied to the free extremity of the other tube, *b*, the water is made to rise from the bottle into the burette. This is continued until a little water overflows through the ajutage, A, of the burette. The cocks, B and D, are closed, the burette is placed upon its support, and the nozzle, E, is introduced into a small glass that stands upon a wooden base. All is now ready for the analysis, and the products that this requires are the following:

We prepare at the same time a liter of each of the liquids used, although the bottles have a capacity of only 100 or 150 cubic centimeters. When empty they are filled anew. (1.) Pure sulphuric acid diluted with its own volume of water. (2.) Potassa dissolved in the proportion of 100 grammes per liter of distilled water. (3.) Pure ammoniacal sulphate of iron. A liter of the solution $\frac{N}{10}$, made with distilled water, contains 39·2 grammes of this salt, and one cubic centimeter of this solution corresponds to 0·8 of a milligramme of absorbable oxygen. The liquid will keep better yet if it be acidulated with twenty cubic centimeters of dilute sulphuric acid. (4.) Pure permanganate of potash. The prepared liquid $\frac{N}{10}$ contains 3·16 grammes of the salt per liter of distilled water. It has a very deep red-violet color. For the estimation of oxygen in water, this liquid is diluted with four times its volume of distilled water, so that ten cubic centimeters of the liquid $\frac{N}{10}$ form 500 cubic centimeters of the liquid $\frac{2N}{100}$. One cubic centimeter of the latter contains 0·16 of a milligramme of disposable oxygen. The numbers 0·8 and 0·16 are theoretical, that is to say, true, if we have employed accurately weighed and perfectly pure salts. These liquids may, moreover, spontaneously alter in time—the iron salt by oxidizing in the air, and the permanganate by deoxidizing. It is well, then, to verify them from time to time before beginning operations. To this end, we hold in reserve, in a small stoppered bottle, some pure oxalic acid in very small crystals or crystalline powder. Of this, 0·315 gr. is weighed out and made into a solution of which each cubic centimeter is capable of taking 0·08 mg. of oxygen from the permanganate. As the solution of oxalic acid does not keep well, the best thing to do is to prepare it every time that it is wanted for use.

The operation is conducted as follows: Our burette, C, is put in place, and the cocks, B and D, are opened. In the first place, with a graduated tube resting in the sulphuric acid bottle, we pour two c. c. of acid into the lower glass, into which enters the end, E, of the burette.



APPARATUS FOR ESTIMATING THE AMOUNT OF OXYGEN DISSOLVED IN WATER.

Then, with a tube drawn out to a point, we extract water from the ajutage, A, as far as to the cock, B, and substitute therefor two c. c. of solution of potassa. The cock, D, is then opened entirely, and B is carefully turned on so as to allow the alkali to pass into the burette without any air accompanying it. The water that it contains is thus rendered alkaline, and sometimes takes on a milky tint when it contains much carbonate of lime. Next, the ajutage, A, is filled with water (the cock, B, being closed), and the latter is then removed with the pointed tube in order to get rid of the excess of alkali. Then, with a gauged pipette, exactly three c. c. of the acidulated iron salt are first introduced into the reservoir, A, and next through the cock, B, into the body of C. Under the influence of the alkali, the oxide of iron is precipitated. If the water in C contains no trace of oxygen, the precipitate remains white, scarcely greenish, and becomes of so much a darker green in proportion as the water contains more of the gas. It may even turn almost entirely of a dark ocher color. As soon as the iron salt is introduced, the cocks, B and D, are closed, and the burette is detached and turned end for end twice so as to form a mixture, and then put back in place. Next, two c. c. of sulphuric acid are poured into the ajutage, A, and, without touching the closed cock, D, B is turned on full. A double current is thus set up through B—water rising from C to A, and acid descending from A to C. The water becomes clear very quickly, because the iron protoxide that remains combines first with the acid; and then the more or less yellow liquid finally loses its coloration. All the oxygen of the iron is redissolved.

Next, the lower glass is removed, and the two cocks, B and D, are opened over a vessel that receives the mixture. When the flow of the latter has ceased, the acid is poured from the glass into A, and the glass is filled anew with water. This washing water should flow over the entire internal surface of C.

The vessel which thus contains the sulphate of protoxide of iron, more or less converted into sulphate of sesquioxide, is placed under the graduated burette filled with $\frac{2N}{100}$ permanganate. This latter is allowed to fall drop by drop until the liquid in the vessel assumes a very clear rose color. We thus know the volume of $\frac{2N}{100}$ permanganate necessary to finish the conversion of the protoxide into sesquioxide of iron. In subtracting this volume from that which it takes to convert three c. c. of the unaltered solution of iron, we have the volume of permanganate that corresponds to the volume of oxygen dissolved in the water.

As the sulphuric acid and potassa that are used may not be pure, it is well to determine the reference point by a blank operation. To this end, we take a volume of water equal to that of the burette and pour into it the potassa and all the acid, shake it up, and finally add the iron salt in such a way that there shall be no precipitate. The volume of permanganate necessary to give a rose color (whether or not the latter disappears in time) is the number that it is necessary to subtract from the volume obtained in a real operation. This number is what we call our point of reference. In our own analyses it is 12·45 c. c.

As the volume of the burette that we use is 114 c. c., four of which pass into the lower glass without having undergone the action of the iron salt, 110 c. c. remain. As the proportion of the $\frac{2N}{100}$ permanganate that we employ is 0·15 mg. per cubic centimeter, in order to pass from the volume 110 c. c. to that of 1,000 c. c., or a liter, we multiply 0·15 mg. by 1,000 and divide by 110, which gives us 1·36.

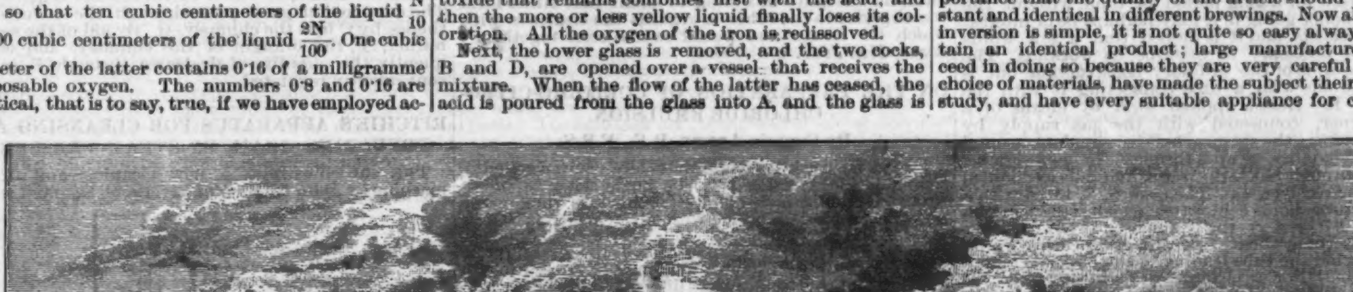
Let us suppose that we have been obliged to pour out 5·75 c. c. of $\frac{2N}{100}$ permanganate in order to obtain a rose color; we shall have 12·45—5·75=6·70; 6·70×1·36=9·1 mg. We conclude from this that the water experimented with contains 9·1 mg. of dissolved oxygen per liter. The maximum that water can take naturally at 0°, and under a pressure of 760, is 12·4 mg.

The quantity of free oxygen contained in the same water varies under many influences. The dissolved organic matters and bacteria which exist therein tend incessantly to diminish it. The contact of free air and the action of light upon aquatic plants tend, on the contrary, to increase it. A certain balance establishes itself between these two opposite influences, and one may hide the other.

At Montsouris we endeavor to isolate these two contrary influences as much as possible. The water to be examined is aerated by shaking it for a few minutes in the air. The burette is filled with it in order to measure the quantity of oxygen that it contains, and then, with the rest, we exactly fill a bottle, which we put into a dark stove heated to 35°. After the water has remained forty-eight hours in the stove, protected from the air and light, we again estimate the volume of dissolved oxygen. We thus find that the volume has decreased under the sole action of the organic matters and their microscopic population. The difference, divided by the time and by the former quantity of oxygen, gives what we call the coefficient of alterability. The maximum is 1·00 for two days, the interval of time that is taken for unity.—*Le Genie Civil.*

THE INVERSION OF SUGAR.

THE comparative ease with which cane sugar can be inverted, and the simplicity of the operation when performed as a laboratory experiment, have led many brewers to try their hands at inverting sugar on a large scale. With the present low prices of raw sugars, there is no doubt a considerable margin of profit compared with the cost of manufactured invert sugar, but we must give a word of caution to brewers not to be led away by the apparent simplicity of the process. In brewing with invert sugars it is of the utmost importance that the quality of the article should be constant and identical in different brewings. Now although inversion is simple, it is not quite so easy always to obtain an identical product; large manufacturers succeed in doing so because they are very careful in the choice of materials, have made the subject their special study, and have every suitable appliance for carrying



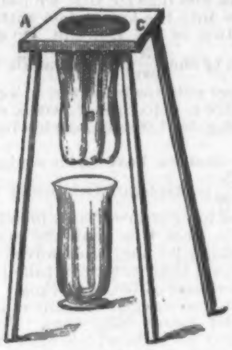
THE NEW UNIVERSITY BUILDING AT VIENNA.

out and checking the process. In a brewery this is not quite so simple, and unless the operating brewer is a thorough chemist, and is able to test the raw materials and the product as it is formed, he runs the risk of producing an article or sirup varying much in quality. We have no desire to deter brewers from adopting any process which will effect economy, and no doubt many brewers are quite capable of carrying out and controlling this chemical operation, but, on the other hand, there are still many brewers whose knowledge of chemistry is scarcely sufficient to justify them in attempting this process, and it is to the latter that we wish to give this word of caution.—*Brewers' Guardian.*

HOW TO FILTER GELATINOUS MIXTURES.

By Lieut.-Colonel W. L. NOVERRE.

A SIMPLE and rapid method of filtering gelatinous mixtures will doubtless be acceptable to many photographers. The plans usually recommended are, the use of a funnel plugged with tow or cotton-wool, or a piece of cambric or other material spread over a jar, on which the solution is poured and allowed to percolate through. These plans are altogether unsuitable where large quantities of liquid have to be filtered, and even for small quantities the process is slow. The gelatine has to be kept warm till the operation is complete, and a rather open material must be employed, or the solution will only fall through drop by drop.



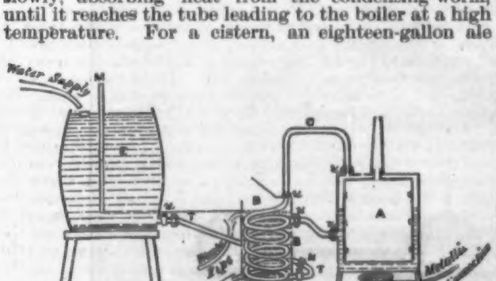
The plan here described will be found very expeditious, there is no waste, a filtering material of the closest texture may be used, and the warm mixture is filtered before it has time to thicken by cooling. It has been used successfully for filtering gelatino-bromide emulsions and the gelatinous mixtures employed in the preparation of carbon tissue. The arrangement referred to is shown in the annexed cut. A is a wooden stand 18 inches high, having a hole in the top four inches in diameter; C is a ring made of bent cane or whalebone, slightly larger than the hole in the stand. The filtering material, which must be of the closest texture, should be cut in a circular form about 22 inches in diameter; when secured to the ring with stout thread it forms a bag, B, the ring, C, preventing it from falling through the opening in the stand.

To use the apparatus, the operator pours sufficient of the mixture into the bag to half fill it; he then seizes the bag, above the liquid, with his fingers, and presses the filtrate through into a receptacle placed below to receive it. Further portions of the mixture are poured in till the whole quantity has been filtered. With the measurements given above, quantities varying from 4 ounces to 40 ounces may be readily operated upon.—*Photographic News.*

A CONSTANT LEVEL STEAM-OVEN AND STILL.

By ALEX. J. ATKINSON.

THE accompanying sketch of a combined steam-oven and distilled water apparatus, so arranged as to be left to itself for a long period of time without the risk of the boiler going dry, may perhaps be of interest to many chemists, and it is hoped that a few words only will be necessary to describe its working. The steam-oven, A, is of the ordinary construction, but is fitted at the side with a tube connecting it with the condenser, B. Heat is applied to A by means of a radial burner, connected with the gas supply by metallic tubing; the steam generated circulates around the drying chamber, escapes through the copper tube, C, thence through block-tin worm, and falls as distilled water in the receiver, D. The cistern, E, fitted with a Mariotte's tube, holds cold water, which falls through the tube, TT, enters the condenser, where it rises slowly, absorbing heat from the condensing-worm, until it reaches the tube leading to the boiler at a high temperature. For a cistern, an eighteen-gallon ale cask, supported on a stool, has been found to answer admirably, having the advantage of holding sufficient water on the top to secure the two corks being air-tight.



By a suitable adjustment of the Mariotte's tube, M, the rate of flow of the water can be so regulated that the level of the water in the condenser is constant, or, if desired, allowed to drop slowly into the waste pipe, while the water evaporated from A is replaced by water already near boiling. In practice it has been found necessary to allow the water to waste at the rate of about two drops per minute, the eighteen gallons lasting for over seventy-two hours, during which time ten to eleven gallons of distilled water are collected. When this apparatus was first fitted up in this laboratory it was intended to have connected the condenser directly with the town water supply, but as the water-works authorities would sanction no such connection we had recourse to the cistern, with the satisfactory result that we are in this respect quite independent of the caprice of the water-works turncock. The several connections are made by union joints at *u u* to allow the apparatus to be taken to pieces and the boiler freed from scale. The whole apparatus may be supported upon a strong shelf, which should be protected from the heat of the burner by means of slates or asbestos millboard. With this arrangement bulky precipitates may be allowed to remain in the steam-oven all night and found ready for further treatment next morning.—*Chemical News.*

SCHROEDER'S CAMERA LUCIDA.

ALTHOUGH mention has several times been made of this instrument in these pages, we have not yet described the precise construction of the prism. It is figured in the cut, which shows the course of the rays of light and the angle at which they enter the prism from the paper.

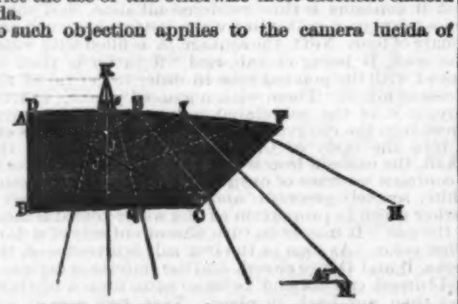
The eye is supposed to be located at K, immediately above the prism, looking directly downward at the drawing paper and pencil, in the direction, K J, the sides, D E and BC, being parallel. The pencil point is, therefore, seen as clearly as it would be through a plain piece of glass.

The image from the microscope is received on the face, F C, the stand being inclined at an angle of 45°. The rays, being totally reflected from the surface, E F, are received on the face, D G, of the upper prism, which is separated from the lower prism by a thin film of air. From thence the rays pass to the eye, and the images of pencil, paper, and object on the stage are received by the eye together.

When the light is properly adjusted, this instrument leaves nothing to be desired; pencil, drawing, and object are distinctly seen, and the light is easily managed. The prism, as some readers will recognize, is the same as was first applied by Mr. Wenham as a binocular prism for microscopes. Not many of those prisms were made for that purpose, however, probably owing to the difficulties of construction.

While commending this instrument in the highest terms, it is but fair to say that, owing to the considerable distance the light has to travel through it from the eye lens, it can only be used with oculars of low power having a long focus back of the eye lens. Otherwise the rays come to a focus within the prism, or at least do not reach the point, K, far enough above the prism to afford a sufficiently large field of view. This fact will greatly restrict the use of this otherwise most excellent camera lucida.

No such objection applies to the camera lucida of



SCHROEDER'S CAMERA LUCIDA.

Grunow, which is the only one comparable with it. In fact, after showing the Schroeder instrument to a well-known microscopist who was constantly using Grunow's form, he was quite unwilling to admit that either form was superior to the other as regards the clearness with which the image and pencil can be seen together.—*Amer. Mic. Jour.*

ON THE PREPARATION OF COLLODIO-CITRO-CHLORIDE EMULSION.

By Captain ABNEY, R.E., F.R.S.

I HAVE been asked several times lately how a collodio-citro-chloride emulsion is to be made when using citrate of ammonia instead of citric acid as the organic body necessary to combine with silver, which is to give vigor to the printed image. It is very easy to do, however, by a little artifice which I have thought might be worth describing. Citrate of ammonia is insoluble in alcohol, and therefore rather difficult to introduce into an emulsion in the ordinary manner; but it can readily be introduced into collodion by the following procedure. Take ten grains of pyroxyline and cover it with half an ounce of alcohol in which twenty grains of citric acid are dissolved, and then add one ounce of ether. This forms collodion containing citric acid. In order to get citrate of ammonia into the collodion in a very fine state of emulsion, ammonia (gas) dissolved in alcohol is added to the collodion. This is effected by inserting a bent tube in a cork in a test tube, which is a quarter filled with liquor ammonia. Placing this in warm water—in fact, nearly boiling water—the ammonia is given off rapidly, and can be made to pass through alcohol contained in another test tube. The alcohol absorbs the ammonia and takes up a large proportion of gas, as those who use sal-volatile may be aware.

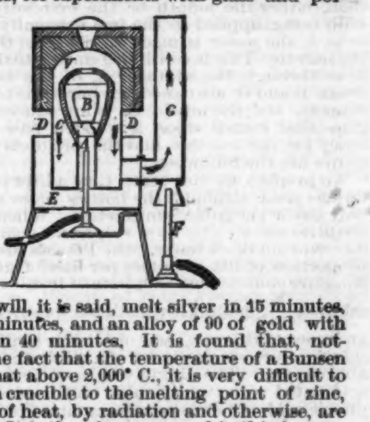
This ammoniacal alcohol is next added to the collodion containing the citric acid, little by little, with shaking and stirring, and sufficient is added till reddened litmus paper shows a very slight trace of alkalinity. A very fine emulsion of citrate of ammonia is thus formed, the grain of which is indistinguishable by the naked eye, and, like other emulsions when first mixed, is orange-colored when spread upon a glass plate. The emulsion is again rendered slightly acid by the addition of a few drops of a solution of citric acid in ammonia. If an emulsion of citrate of silver be required, there are two ways of effecting it—one by dissolving (say) ten grains of silver nitrate in the least possible quantity of water, to which is added one drachm of alcohol, and gradually dropping it into the collodion containing the citrate. It sometimes happens that this gives a granular emulsion. If, however, the silver nitrate be coarsely powdered and added to the emulsion, a very fine emulsion of citrate of silver is produced by shaking. This may be washed in the usual way, or may be precipitated by pouring in a fine stream into water. Another method of forming the citrate of silver is to pour out the emulsion of citrate of ammonia into a flat dish, and when well set, to cover it with a solution of silver nitrate. It is then drained from the silver, washed, and dried as usual. When redissolved, the emulsified citrate of silver should be excessively fine.

To prepare a collodio-citro-chloride emulsion, two plans may be adopted: either to dissolve twenty grains of dry calcium chloride in a small amount of alcohol, and add it to the citrate of ammonia emulsion, and then to add 80 grains of silver nitrate to it in the usual way. What I prefer, however, is to make a collodio-chloride emulsion separately, and then to mix the citrate of silver emulsion with it, according to taste.

To make a pure collodio-chloride emulsion, I dissolve twenty grains of calcium chloride in half-ounce of alcohol; add to it five grains of pyroxyline, and then half-ounce of ether. To one ounce of plain collodion made similarly, I add sixty grains of silver nitrate dissolved in the smallest quantity of water, to which is added one drachm of warm alcohol. This produces an emulsion of silver nitrate in the collodion. To this the chlorized collodion is added drop by drop with stirring or with shaking in a bottle, and a perfect emulsion of silver chloride should result. This can be poured out to set in a dish as usual, and washed, dried, and redissolved; or can at once be poured out in a fine stream into a large bulk of water, squeezed, soaked in alcohol twice, wringing out in a cloth all excess of alcohol each time. It can then be redissolved in the one ounce of ether and one of alcohol, and should give a good emulsion. The two emulsions may then be mixed together as before stated. It is well to dissolve about five grains of silver nitrate in water and alcohol, and add to the emulsion in order to increase the rapidity of printing.—*Photographic News.*

A REGENERATIVE GAS FURNACE FOR LABORATORY USE.

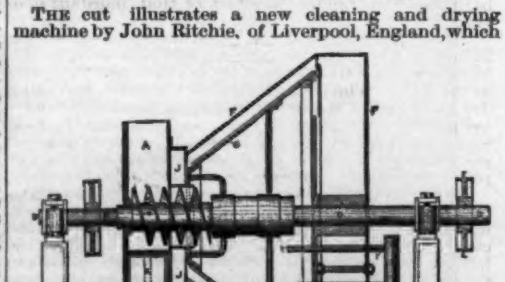
THE accompanying illustration, from *Dingler's Polytechnisches Journal*, shows a furnace (to some extent regenerative in its action) especially applicable for metallurgical work, for the ignition of precipitates, the fusion of silicates, for experiments with glass and porcelain, etc.



It will, it is said, melt silver in 15 minutes, fine gold in 20 minutes, and an alloy of 90 of gold with 10 of platinum in 40 minutes. It is found that, notwithstanding the fact that the temperature of a Bunsen flame is somewhat above 2,000° C., it is very difficult to heat a porcelain crucible to the melting point of zinc, since the losses of heat, by radiation and otherwise, are so considerable. It is therefore arranged in this furnace that cold air, in carefully regulated quantity, is admitted to the Bunsen burner, A, through E; and has its temperature raised, during its passage, by contact with the heated jacket, D. The combustion takes place within the muffle, C, which surrounds the crucible, B. The combustion gases pass through the cover of V, thence by C into the chimney, G. By aid of the second burner, F, the draught of the chimney, and consequently the quantity of air drawn through E, can be conveniently regulated.

RITCHIE'S APPARATUS FOR CLEANSING AND PREPARING GRAIN BY STEAM PRESSURE.

THE cut illustrates a new cleaning and drying machine by John Ritchie, of Liverpool, England, which



APPARATUS FOR CLEANING AND PREPARING GRAIN BY STEAM PRESSURE.

it is said not merely dries washed wheat so thoroughly that after standing for an hour in sacks it is hard enough to grind, but it cleans even the crease of wheat without in any way injuring the bran or breaking the grain. Referring to the sketch, A is the feed hopper; B, screw feeder; C C, conical centrifugal perforated

cage, revolving at high speed on shaft, D, by means of pulley, E, or otherwise; F, casing; G, dust-hole, opening into the same at bottom, and collecting the heavier dirt that passes through the cage; H H', spout and door, respectively used to remove the dirt from time to time; I I I, P P P, are three steam jets, blowing in steam at 60 lb. pressure; J, exhaust passage from the casing; K, exhaust fan; L, exit passage for grain—the grain is fed into the cage by screw, B. While being centrifugaled it meets the dry steam, which, rushing over its surface and along the crease, takes off the dirt and dries the grain; the latter passes out at L, but the steam and dirt pass through the cage, the steam preventing the pores from choking-up; the heavier dirt falls into G, the lighter rushes on with the steam to the fan, the strong current keeping the casing bright and clean. This machine, it is said, is also of great benefit in the manufacture of rice, barley, groats, and split peas.—*The Miller.*

FABRICS STAINED IN THE MANUFACTURE.

A. ROGER, of the Societe Industrielle d'Amiens, has recently prepared and presented a report on the nature of stains found on bleached, dyed, and printed fabrics. Such goods are classed as damaged. If sold, the abatement demanded entails loss on the manufacturers. If intended for further treatment, either in the dyehouse or print works, the stains interfere with the production of the tints desired.

The evil complained of is no new discovery. Chemists and experts in weaving have often united their efforts to discover effective means of avoiding it, but despite their laborious efforts the origin and the causes of the damage have not yet been sufficiently and incontestably defined.

In 1866 a report was made to the Chamber of Commerce of Manchester, in which it was demonstrated that stains on tissue are produced by the use of impure soaps and chemical salts, which attack fibers of all kinds of textiles and disintegrate them. Another cause is the generation and growth of a minute parasitic plant in the body of the goods.

In India a special commission was appointed to inquire into the origin and the causes of the stains on cotton cloth imported from England. The result of the inquiry ascribed the injury to the use of improper sizing and of substances added to increase the weight, the effects of which were more damaging because of the prolonged storage of the goods in damp warehouses. Many of the cloths had become mouldy from the action of the impure materials used in the bleaching and finishing, such as soap, tallow, grease, etc.

White soap, says the report, is not a mere mixture of water, tallow, and alkali thrown together in any proportion whatever, but on the contrary a chemical compound consisting of 33 per cent. of water, 60 per cent. of fat, and 7 per cent. of alkali. This is the only soap not altered by contact with the substances of which the size is formed. The mixture of resin and alkali, in which common salt is often found, should never be used to stiffen. The quality of the size employed is more important than its quantity. Five per cent. of chemical agents, such as the chlorides of zinc, magnesium, aluminum, or calcium, mixed or separate, is worse than a large proportion of paste made of starch. The remedy for the evil would seem to be to return again to the processes of sizing and thickening which involve the use of no drugs.

Among the other causes of stains are some classed as accidental, of which the following may be taken as examples:

1. "Mastic" stains.—Weavers not unfrequently get oil on their cloth. To conceal it they cover it with Spanish white. A lime salt or "mastic" is formed, insoluble in the baths used to prepare the goods for the dye vat, especially when the stain has had time to harden.

The means in use to remove these stains are their decomposition by a warm, dilute hydrochloric acid bath. This sets free the oil, which is removed by soap and soda, but the process has the inconvenience of altering the quality of the tissue. It were better for the workmen to leave the spots of grease as they are formed, instead of seeking to hide them by a material which makes them worse.

2. Tobacco stains.—Cloth woven by careless workmen who chew tobacco is sometimes spotted with the spittle. This kind of tannin has the property of fixing certain colors on cotton. It forms an additional mordant to attract color. It is especially annoying when the fabric contains two or more kinds of fiber. Perhaps the best way to prevent the stains from showing after the dyeing, is to put the whole piece into a tannin bath, and thus render the effect of that mordant general.

3. Bars produced by light.—Sun and air have a strong influence on textile materials, especially wool. Unbleached goods thus exposed for a long time turn white in the folds. The fiber, if animal, is altered, becoming dry and harsh. When the tissues are dyed, these parts are not found charged with so much color as the rest, and each of the former folds shows a bar. To avoid such damage the goods should be wrapped in stout paper, and, perhaps better, should be rolled.

4. Iron mould.—Stains of iron rust are sometimes produced under circumstances which exempt the workman from blame, but generally viligance can detect the cause and remove it. The fiber may in combing be left too long on the damp chain, or through defects in the body of the card clothing, which ought to be observed and reported, teeth in whole or in part are detached and fix themselves in the fiber. One of these pieces of steel in contact with the mordant will occasion stains more or less widespread.

If a number of pieces of goods, but one of which contains detached card teeth, be put in the dye vat, all the others will be stained on their exposed surfaces. In this case the piece which contains the teeth can without difficulty be found, as the stains are produced in the body of it, and the iron can be removed. For the extraction of iron mould a weak bath of oxalic acid is recommended, but to guard against injuring the fiber, solutions of acid oxlates of the alkalies are to be preferred, potassium dioxalate, long known as "salts of sorrel," being perhaps the best. Neither the acid nor its salts can be used if the material has been dyed with certain colors. Such cases require specific treatment, which sometimes costs more than they are worth, and the success of which is often doubtful.

[AMERICAN ARCHITECT.]

THE WASHINGTON MONUMENT.

THE subject of a national memorial to Washington was early discussed, and took such shape that the Continental Congress of 1783 adopted a resolution for the erection of a monument "in honor of George Washington, the illustrious Commander-in-Chief of the United States Army during the war which vindicated and secured their liberty, sovereignty, and independence;" but Washington would not allow the resolution to be carried into effect during his life. After his death, the House of Representatives in the Congress of 1800 passed an act to erect to his memory "a mausoleum of American granite and marble in a pyramidal form." But it failed of passage in the Senate, and it was not until 1833 that the monument project assumed definite form, when the Washington National Monument Society made an appeal to the country, and secured $230,000. Work was not begun, though, until 1848, when the site, said to have been originally chosen by Washington, of the present monument was designated by Act of Congress. It includes twenty acres of the Government reservation along the Potomac River, and will eventually be a portion of a beautiful park.

The Society proceeded with the work of construction, after having laid the corner stone July 4, 1848, until 1854, when it was compelled to suspend operations on account of its inability to obtain more money. The monument was left a little way above its foundation until 1878, at which time the Government undertook its completion, under the direction of the United States Corps of Engineers, with the Monument Society as an advisory board. After a large appropriation by Congress this Joint Commission ordered work to be resumed January 28, 1879. The necessary earth excavations for uncovering the old marble foundation were begun, and two cuts were made beneath the work, on diagonally opposite corners, and speedily filled with concrete; but the removal of 144 square feet of bearing surface from beneath a foundation and shaft 180 feet high and weighing 71,500,000 pounds was found to give such rapid motion to the monument that only one cut at a time was made at the remaining angles and opposite sides. The entire mass of new concrete beneath the old foundations is 126 feet 6 inches square, 13 feet 6 inches in depth, making a total depth of 36 feet 10 inches, and extends 18 feet within the outer edge of the old foundation, and 23 feet 3 inches without the same line. The mass contains 7,037 cubic yards of Portland cement concrete, of a mixture by volume of one part cement, two parts sand, three parts pebble, and four parts broken stone. This concrete possessed a crushing strength, when seven and one-half months old, of 155 tons per square foot.

The entire work of underpinning was accomplished without causing the slightest crack or the least opening in any joint of that portion of the monument already described. The area of the original rubble foundation was 6,400 square feet to which was added 16,002 square feet of concrete, a surface two and one-half times as great, and as the monument, as now completed, weighs 80,470 tons, this will give a normal pressure on the bed of the foundation of more than 3½ tons to the square foot, which will be increased to a maximum pressure under the action of the wind. The shaft, which is 555 feet high, has a base of 55 feet; it is therefore ten diameters high, with an entasis of one foot in every thirty four in height. It is faced with white, large crystal marble, and backed with blue granite; but as the walls increase in height, the proportion of granite diminishes, and at the level of 452 feet the backing disappears, and the walls from that level to the top are entirely of marble. The settlement of the structure varies at each corner, but the average is 1·7 inches.

The interior of the monument consists of an iron frame, in two parts, one of which carries the stairs and landings, the other the elevator machinery; as the work progressed, this was utilized for lifting the stones.

The stair frame-work consists of four wrought-iron Phœnix columns, 7¼ inches in diameter, which are located at the four corners of a square 15 feet 8 inches on a side, and concentric with the hollow well of the monument shaft. At levels of 20 feet, the one above the other, nine inch beams were passed through the two east and two west columns, and the ends of these beams firmly secured in the north and south walls of the shaft. These beams formed the inner edges of strong wrought-iron frames, which constitute the landings, the outer edges being made by nine inch channel bars, the ends of which are firmly secured in the north and south walls. The landings are thus located along the east and west faces of the well, and are so spaced vertically that any landing on the east wall is ten feet above the next landing below it on the west wall. These landings are then connected by iron staircases along the north and south faces of the well, the inner carriages of the stairs being bolted into the columns. The elevator shaft is formed by four Phœnix columns, 6 inches in diameter, placed at the four corners of a square, 9 feet 9¼ inches on a side, and concentric with the square formed by the four columns of the staircase frame. These columns are securely fastened and braced to the columns of the staircase. Upon the northwest and southeast columns, the girders and ratchets for the safety-pawls of the elevator are fastened, while upon the top of these columns an iron frame-work carries the large pulleys for the hoisting-ropes and other minor parts of the mechanism.

During the progress of the work, the eight columns above mentioned were built to the height of 30 feet above the top of the masonry shaft, and firmly tied and braced with vertical and horizontal ties and horizontal braces, making a rigid structure. To each of the four outer columns of this frame-work a crane arm was attached, which swung over one-quarter of the top of the wall. Each of these arms had a mast 18 feet in height, and a boom 19 feet 6 inches in length, and was supplied with a traveling car and differential hoisting pulleys. By means of this arrangement, 20 feet in height of masonry was added to the walls of the monument. It would then become necessary to add 20 feet to the height of the iron frame, and to move the elevator and stone-setting machinery to its top, when another 20 feet of wall could be built. This alternation of building first 20 feet of the iron frame and 20 feet of the walls was continued to the top of the structure.

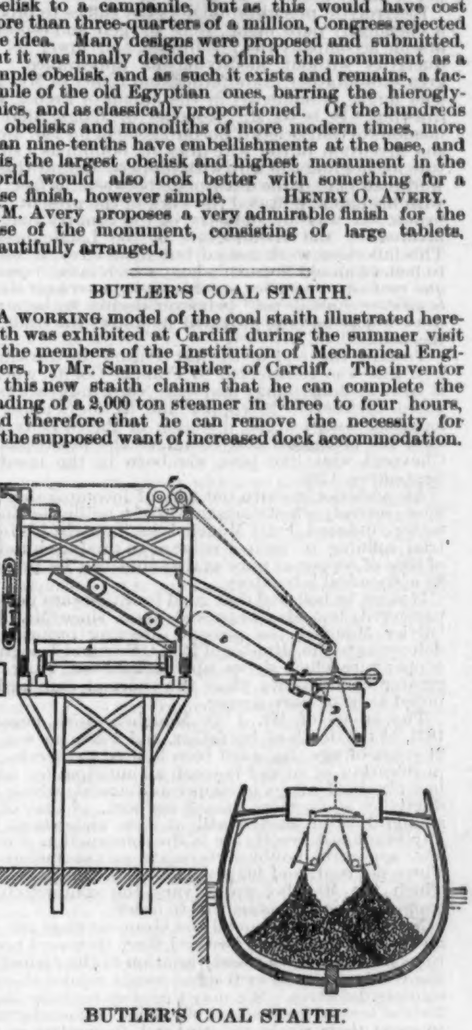
In 1883, the appropriation of 1878 having been exhausted, Congress devoted another large sum of money, sufficient to finish the monument, including the interior staircase and platform, the masonry of the well, the paving of the floor, and the passenger elevator, which has a capacity for a load of six tons, with a large factor of safety, and can easily accomplish two trips an hour. No account was taken, though, in this last appropriation, for any embellishment of the door-ways, the terrace, and approaches to the structure, the insertion in the walls of the presentation stones, the final disposition of the boiler house, or of appliances for lighting the interior of the shaft. The monument has already cost $1,250,000, and if these are properly carried out, another quarter of a million will be necessary.

It was always intended to have some finish at the base of this obelisk, and to this effect Congress approved an idea of Mr. Robert Mills, an American sculptor, which changed the monument into a sort of Pantheon, 100 feet high, with a colossal statue, over its portico, of Washington in a chariot, with six horses driven by Victory; but this was finally abandoned, and later the Joint Commission approved a design by another sculptor—Mr. Story—by which the entire obelisk was to be embellished by an ashlar covering, of porticoes, cornices, pilasters and niches, changing the character from an obelisk to a campanile, but as this would have cost more than three-quarters of a million, Congress rejected the idea. Many designs were proposed and submitted, but it was finally decided to finish the monument as a simple obelisk, and as such it exists and remains, a facsimile of the old Egyptian ones, barring the hieroglyphics, and as classically proportioned. Of the hundreds of obelisks and monoliths of more modern times, more than nine-tenths have embellishments at the base, and this, the largest obelisk and highest monument in the world, would also look better with something for a base finish, however simple. HENRY O. AVERY.

[M. Avery proposes a very admirable finish for the base of the monument, consisting of large tablets, beautifully arranged.]

BUTLER'S COAL STAITH.

A WORKING model of the coal staith illustrated herewith was exhibited at Cardiff during the summer visit of the members of the Institution of Mechanical Engineers, by Mr. Samuel Butler, of Cardiff. The inventor of this new staith claims that he can complete the loading of a 2,000 ton steamer in three to four hours, and therefore that he can remove the necessity for or the supposed want of increased dock accommodation.



BUTLER'S COAL STAITH.

A dock would, at this rate of loading, be enabled to ship four to five times the quantity of coal that is now being shipped. The claims which are set forth as being met by this invention are: To avoid the loss of time in moving a ship while loading; to economize quay space by keeping the ship stationary; to load into two or more hatchways at the same time; to avoid loss of time in trimming the cargo by putting the coal in one part of the hold while the trimming is done in another; to do away with the necessity of double screening by avoiding the breakage now occasioned by allowing the coal to drop from the mouth of the chute into the ship; to save labor by doing a considerable amount of the trimming by appliances; to enable bunker coal to be put on board at the same time as the cargo.

The principal feature of the invention is the use of a traverse table for conducting the wagons horizontally to and from the sidings to any point along the quay at which it may be required to tip. In working from a high-level railway, lifts may be dispensed with, the coal being lowered down from the mouth of the chute into the ship by means of an anti-breakage box, which saves breakage and trims the cargo. The coal is lowered by a brake, the weight being taken up by chains attached to the doors. There are other chains attached to the box, so that at any point of its descent, by releasing one brake and taking another, the tension of the chains may be transferred from the doors to the box itself, thus permitting the doors to open by the pressure of its contents, which distributes itself in the ship, and the box being empty, is brought back to the mouth of the chute by a balance weight.

The chute and tipping cylinder are mounted on a frame spanning the traverse table, to which it may be attached for moving to any point required, the motive power being hydraulic. The traverse table, being detached, is free to run to and from the sidings with the wagons. Any number of these traverse tables may be worked along a quay by extending the stage. For shipment from low level railways, where the wagons have to be lifted, they are run off the traverse table into an ordinary staith, which is mounted on wheels and provided with appliances for moving to any position required.

Our engraving gives a side elevation, in which A is the traverse table; B, the tipping cylinder; C, the chute; D, the trimming box; E, levers and rocking shaft for opening and shutting the mouth of the chute by the action of weights; F, pulleys for lowering the trimming box; G, balance weight for bringing the trimming box back when empty.—*The Engineer.*

ON THE DRAWING OF COPPER WIRE.

HAVING been invited by Mr. Mouchel to visit his Aube, Boisthorel, and Tillieres wire-drawing works, we eagerly availed ourself of this chance to initiate our readers into an art which, among all others, is most important as regards the study and the utilization of electricity.

These works, which are located near Laigle, in Normandy, date from the 17th century. Nowhere in Europe has the art of the wire-drawer been carried so far as in the Mouchel works; and nowhere do we find wires of so extreme fineness and so high conductivity. This is because these two valuable qualities have one origin in common—the absolute chemical refining of the copper or alloys used.

Electrolytic precipitation does not suffice to produce a chemically pure metal, since oxygen and especially arsenic accompany the precipitate, and lower its conductivity without modifying its appearance. The great-grandfather, grandfather, and father of Mr. Mouchel figure prominently in the annals of French wire-drawing. It is to Mr. Mouchel of Laigle that the memoirs of the Societe d'Encouragement for 1807 ascribe the invention of the wire-drawing bobbin as a substitute for holding the wire with nippers. Before this the workman placed the draw-plate between his feet, and, with his hands, imitated the work of the present draw-bench. It was an industry of the country that was favored by the manufacture of the Laigle needles. This laborious work caused but little envy, if we are to believe an old Norman adage, which says, "*Quiconque veut estre traiflier, estre le puet, pourcu qu'il sache le mestier et ait de col*" (whoever desires to be a wire-drawer may be one, provided he knows the trade and has neck).

Toward the end of the last century the drawing of iron wire was transferred to Franche-Comte, where it is always flourishing, and the Normandy works devoted themselves to copper and its alloys under the energetic and learned direction of Pierre Felix Mouchel, the colleague and friend of the illustrious Mr. Chevreul, who, like him, was born in the month of September, 1786.

An ambition to turn out wire of incomparable fineness—scarcely a few thousandths of a millimeter in diameter—induced Felix Mouchel to improve his industrial refining to such a point as to produce hundreds of tons of copper as pure as that that can be prepared in a chemical laboratory.

It must be believed that good traditions are not only preserved, but also improved upon, since Mr. Jules Olivier Mouchel, the present directing proprietor, is delivering to the Minister of Post Offices and Telegraphs copper wire which shows, upon official test, 2 per cent. greater conductivity than the normal standard reputed to be of pure copper.

The labors of Mr. J. O. Mouchel, which began in 1871, at the death of his father, and when he was but 21 years of age, have not been limited to carrying the purification of copper beyond all anticipation, for he has obtained alloys of copper and arsenic whose conductivity is no more than 3 per cent. of that of the standard. Our readers will at once understand how important such results are in the construction of resistance apparatus, bobbins, rheostats, galvanometers, etc. Three per cent. and 102 per cent. are the limits between which the Mouchel works vary the conductivity of copper, either voluntarily or to order.

Now that the Paccinotti and Gramme rings are submitted to velocities of two and three thousand revolutions per minute, the least variation in the diameter or the conductivity of each spiral would render them absolutely defective. We may therefore consider the efforts of several generations of extensive manufacturers to excel their rivals and to excel themselves as very fortunate for the development of discoveries in electricity. It is only since the improvements that have been introduced by Mr. J. O. Mouchel that special coppers have been found in France for the manufacture of submarine cables and dynamo-electric machines. Before this, it was necessary to go to England to find them, while now it is England that comes to Boisthorel to get wires of exceptional conductivity.

Figs. 1 and 2 give an external and internal view of one of the wire-drawing shops, properly so called, that of Boisthorel, built upon the Rille, in the very same place where the wire-drawing works were founded in 1646, in spite of the opposition of the high and powerful Baron de Laigle, who feared that he would see the Rille exhaust the power of its waters, to the great detriment of his Laigle mills that were located a league up stream.

The statement which was drawn up by lawyers at that period, and which is preserved among the parchments of the Mouchel family, bears witness to the persistent energy of the wire-drawers of the 17th century. Our visit to the works proved to us that the present owners, superintendents, and workmen were worthy of their ancestors, and we were particularly struck with the fine appearance of all these workers. Their faces showed health, and the sight of those yellow or red wires incessantly accumulating upon their bobbins, where they assumed the brilliant appearance of gold, and the merry valley covered with apple-trees, where nine-pins are played on Sunday—all this united gives Boisthorel the aspect of a little Eden.

Let us add for the credit of these honest people that although copper is a monetary metal they are not submitted to any special surveillance, and never is the least particle of metal found missing by those who are responsible for it. The buildings located upon the left bank of the Rille contain the refining furnaces and the laboratory, and those on the right the rolling-mills moved by the fall of the water, while behind are the pickling reservoirs. The bars of metal that come from the moulds are first submitted to the action of the rolling mills and are then annealed in large reverberatory furnaces, and afterward rolled again. When they have reached a diameter suited to the draw-plate, and which is variable according to the metal, they are carried to the draw-bench, shown to the right in Fig. 2.

The bar, having become a wire, is dipped into water containing sulphuric acid, then washed systematically in successive vessels, and finally dried in a stove. After this the drawing is begun upon a large bobbin with horizontal axis, like the one shown to the left in the same figure. It is dipped, washed, and dried as before, and these operations are performed at every finer and finer drawing until the wire has reached the fineness required.

The necessity of these repeated dippings will be readily understood; without them, in fact, the slightly conical aperture in the draw-plate would be quickly obstructed by oxide of copper, and this substance, which is relatively hard, would enlarge the hole and cause the wire to lose its perfect form. Moreover, the draw-plates would quickly wear out, and their cost is not an unimportant matter.

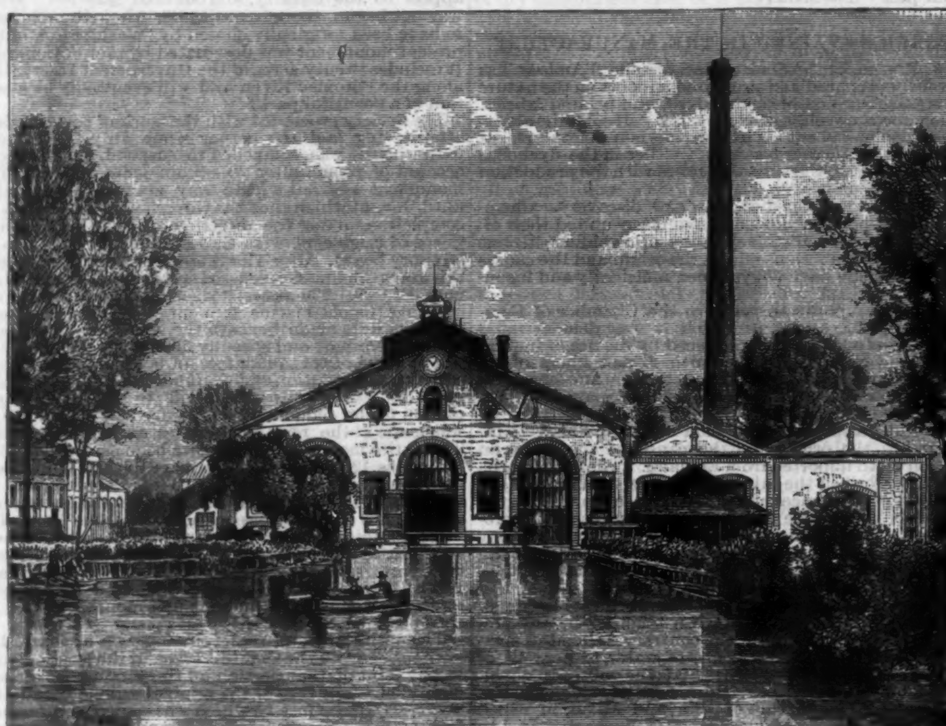


FIG. 1.—EXTERNAL VIEW OF THE BOISTHOREL WIRE WORKS.

The draw-plates for coarse wire, shown in Fig. 4, are of steel, and are from 30 to 40 millimeters in thickness. Their temper varies according to the metal. Their apertures are not bored out, but are made with a punch.

The left wall of the shop, of which we give an internal view, is provided with a closet in which are kept with jealous care, by the workman who made them, punches of all sizes and shapes. Those designed for making die-plates for mouldings and for clockwork pinions are genuine chefs-d'œuvre. When the wires are of smaller diameter, sapphire draw-plates are substituted for steel ones. For still finer wires recourse is had to rubies, and exceptionally fine wires designed for telegraph cables, telephone bobbins, etc., are made with diamond plates (Fig. 5).

We were present during the manufacture of these plates from precious stones in a special shop connected with the Tillieres works. It it certainly a strange spectacle to see all these little clockmakers' lathes carrying drills that can only be perceived with a lens. Their rotary velocity is about ten thousand revolutions per minute. Every two or three seconds the little diamond tablet which is to become a draw-plate receives a slight recoil motion in order to facilitate the penetration of the oil, which holds diamond powder in suspension. Now, in order to pierce and counter-pierce a diamond tablet one millimeter thick, it requires twenty days' revolution of the little drill which makes 10,000 revolutions per minute. The diamond is afterward set in the center of a copper disk of the size of a silver five-franc piece. Wires that are only a few thousandths of a millimeter in diameter are sometimes made of platinum, and in this case are designed for astronomical instruments.

All the drawing bobbins resemble the two shown in Fig. 4. The workman throws them into and out of gear by means of a lever that he holds in his hand. A piece of oiled linen placed in front of the draw-plate keeps the internal surface in a state favorable to the sliding which accompanies the compression of the wire. To give an idea of the product that these innumerable bobbins are capable of yielding, we will say that in the single shop which we illustrate herewith the sum total of the lengths that pass through the draw-plates per minute exceeds six kilometers. Recently, 160 kilometers of $\frac{2}{10}$ wire were manufactured to order, and got ready for shipment, in ten days only. On a visit to the Tillieres works, where the finest wires are made, our attention was attracted by a host of machines that it would take too long to describe in this place. We shall merely name those that serve to put the wire on the bobbin and to automatically and instantaneously throw the spindle out of gear when an accidental resistance exposes the wire to breakage.

In this way there are obtained rolls that contain from 50 to 90 kilometers, and that have to be handled to prevent their being mistaken for cocoon fibers. The baths for tin and lead coating wires designed for foggy countries, and those for nickelizing and silvering, present less interest from an electrical point of view, so

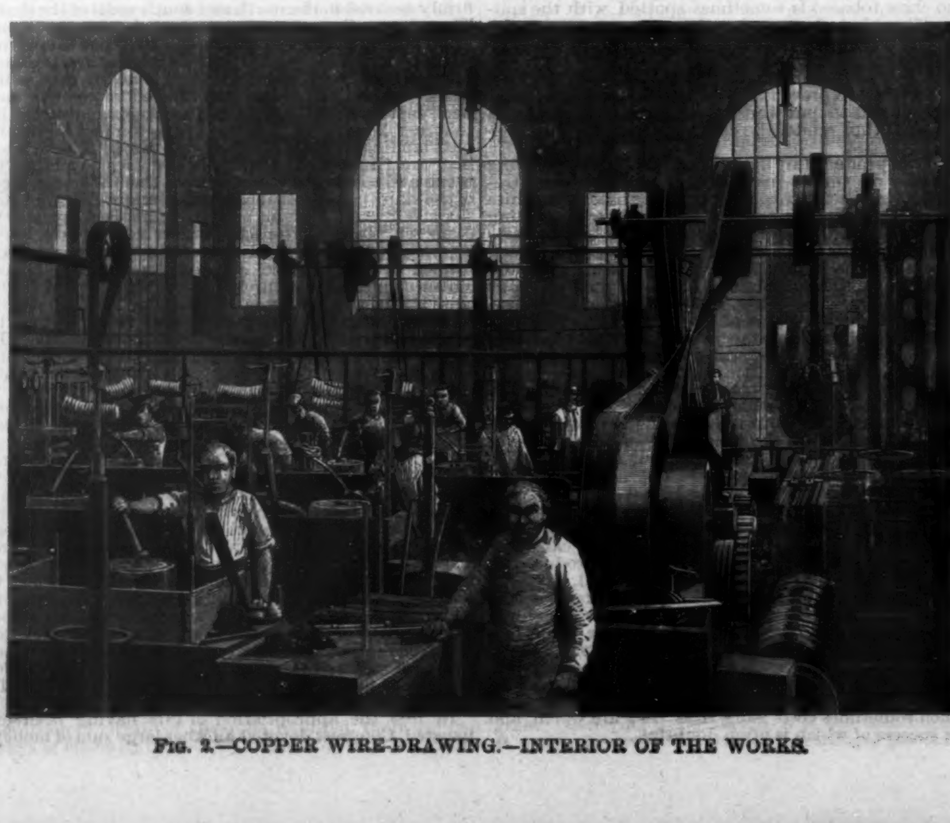


FIG. 2.—COPPER WIRE-DRAWING.—INTERIOR OF THE WORKS.

we merely mention them. We wish, however, to make known to our readers the Mouchel gauge.

The well known little instrument called a Palmer is used for measuring the thickness of metal plates. When employed likewise for measuring the diameter of wires, it has the inconvenience of crushing the metal without the operator being aware of it, especially when the wire is annealed.

Certain manufacturers have tried to remedy this defect by providing the head of the pressure screw with a click arrangement. As soon as the pressure is sufficient the screw ceases to revolve, and the noise of the click is a sign that it is time to proceed to read the vernier. This is certainly very ingenious, but we give preference to the apparatus of Mr. Mouchel.

This gauge contains a slit of triangular form, 15 centimeters in length. The base is one millimeter in width. One of the sides is divided into one hundred equal parts, so that upon introducing a wire into the slit we have at once the number of hundredths of a millimeter. The other side carries the numbers corresponding to the old and arbitrary gauge still in use, called the Carcasse. On the other surface one might engrave the divisions of the Birmingham gauge; the only difficulty would be to find two of these latter that were alike. The millimetric gauge, called the Mouchel, is certainly destined to be adopted by all electricians.

It might at first sight be supposed that the angle of the gauge (which we shall call a) involves an error of reading, and that in order to be accurate it would be necessary to multiply the diameter read by $\cos \frac{a}{2}$; but this not so. This is due to the fact that the base of the triangle is not exactly one millimeter, seeing that, in order to regulate the instrument, we introduce a standard steel wire exactly one millimeter in diameter opposite the division 100. In this way the correction is automatic, and it suffices to read the division corresponding to the center of the wire in order to obtain its true diameter.

We cannot leave the Boisthorel works without speaking of the laboratory tests made in our presence by Mr. Motte, a skillful chemist who has long been attached to the Mouchel establishment. The most interesting of such matters to the electrician is the electric resistance of the conductors that the industry offers us. We need not occupy ourselves with the manufacture, properly so called, and the secrets of each.

The nature of the alloy does not even concern us, and, without expressing our personal ideas upon this delicate question, we do not hesitate to accord our preference to that conductor which, with a given diameter and at a given price, and with the least weight and electric resistance, presents the greatest resisttance to breakage. From this point of view the experiments which we made in the Mouchel laboratory gave results that are worthy of being made known. They relate to two sorts of patented chrome bronze wires—telephonic and telegraphic. Wires of the same diameter, selected from different bundles, were taken at random from the warehouse, and, after their diameter had been verified and they had been tested in the Perraud machine, in order to measure the breaking load, we made some electric measurements with all desirable care by means of the Thomson apparatus. The tests were repeated several times in succession, in order to prevent any chance of error.

The following is the result that we obtained:

The temperature of the laboratory was 90 degrees. The bronze called telephonic was 114 hundredths of a millimeter in diameter. Its electric resistance was 58½ ohms per kilometer, and it required a stress of 77 kilos to break it.

The bronze wires called telegraphic had a diameter of only 110 hundredths; they broke under a load of 45·8 kilos, but their electric resistance was only 18·62 ohms.

A specimen of the latter is suspended in Boisthorel Park upon poles 200 meters apart. All comment is here useless. Our readers will easily make a reduction to 0° and to a square millimeter for each wire. We have often had to test other bronzes, but we affirm that we have never seen results that compared with these.

It is well known that absolutely pure copper is soft, and that the least mixture with another metal in order to increase its tenacity considerably diminishes its electric conductivity. In spite of the interest that this latter quality presents, bronze wires of great tenacity are very desirable for aerial lines in passing through cities. They do not obstruct one's view, and their slight weight renders their accidental breakage harmless. The means by which Mr. Mouchel has succeeded in reconciling two qualities that appear to be antagonistic—tenacity and conductivity—are one of the secrets of the manufacture that we made no efforts to learn, and as we left we whispered the old proverb quoted above—"Whoever desires to be a wire-drawer may be one, provided he knows the trade," etc.—*J. Bourdin, in La Lumière Electrique.*

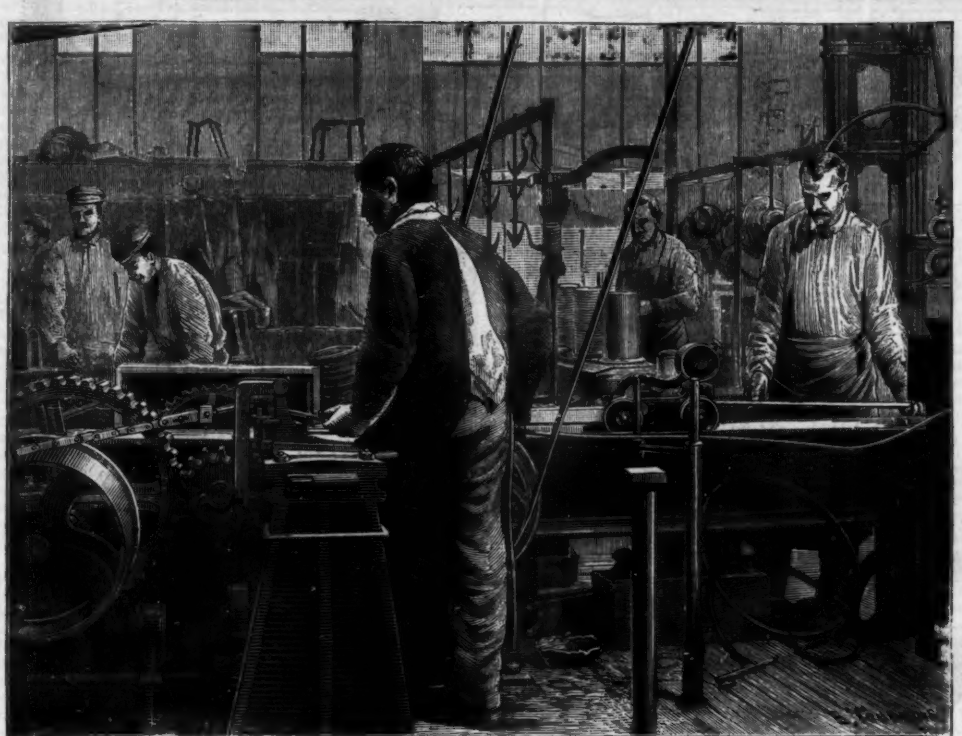


FIG. 3.—HORIZONTAL BOBBIN AND DRAW-BENCH.

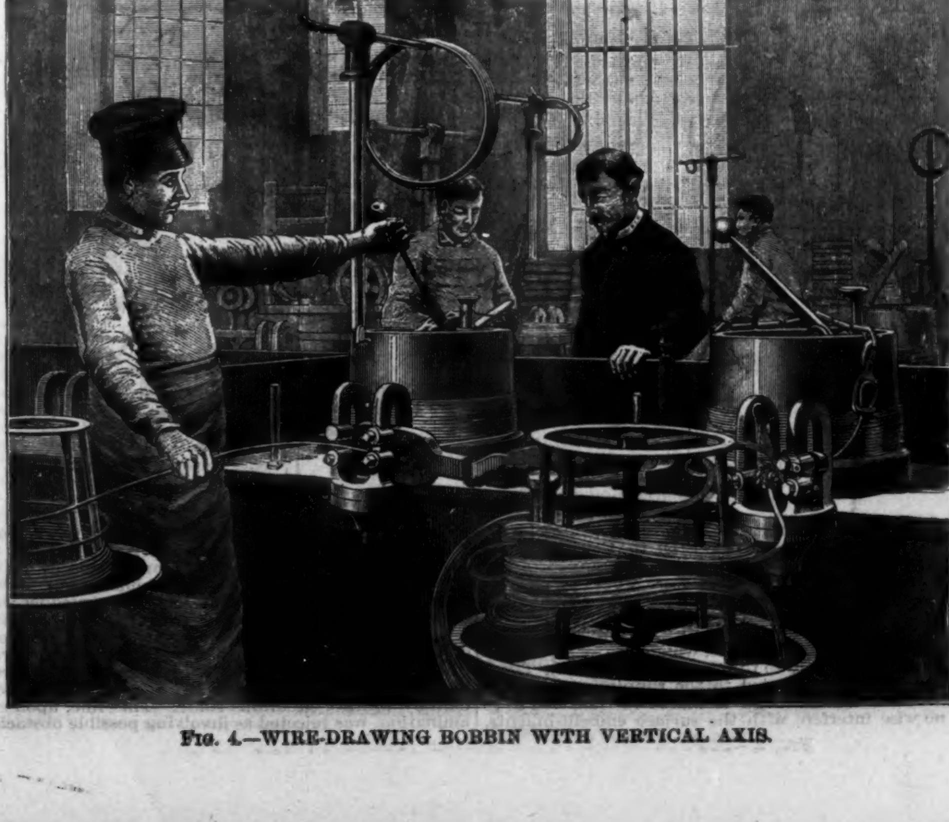


FIG. 4.—WIRE-DRAWING BOBBIN WITH VERTICAL AXIS.

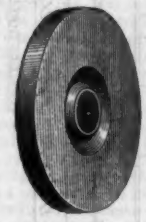


FIG. 5.—DIAMOND DRAW-PLATE.

THE NEW CROTON AQUEDUCT.

WITH this issue we give a map and profile and general plans for tunnel and special shafts of the new Croton aqueduct, the first of a series of plans of this important engineering work which we propose to publish.

As a preface to our general description, we commence with as complete a historical sketch of the inception of the new aqueduct as the meager and scattered sources of available information will permit. In 1875 two projects, known as the Sawmill and Bronx River plans, were submitted for supplementing the water supply of the city of New York, but owing to their enormous cost, insufficient supply proposed—150,000,000 gallons daily—and other reasons too numerous to record here, both schemes were rejected, and no further definite action was taken until 1881, when the present aqueduct plan may be said to have had its birth. In the year last named a bill was framed and submitted to the Legislature asking for authority to build the works required. This bill was strongly indorsed by the city authorities, and in May, 1881, it passed both branches of the Legislature. Although the engineers of the Croton department personally appeared before Governor Cornell and vigorously urged the signing of the bill as a measure of great public necessity, this signing was delayed until the limit of time expired, and the bill failed to become a law.

The Department of Public Works took advantage of this forced delay by making further and more complete surveys for the contemplated work, and its plans were recommended for general economy, efficiency, and permanence by J. B. Jervis, E. S. Chesbrough, and J. B. Francis, three of the most experienced hydraulic engineers in the country; Mr. Chesbrough had been directly connected with the project as consulting engineer for several years.

In 1883, under a new State administration, another Croton aqueduct bill was framed with great care, imposing all possible checks and restrictions upon any features likely to interfere with its passage as a public measure of great urgency.

A resolution of the Senate, of January 9, 1883, requested Mayor Edson of New York to appoint a committee of five citizens to examine with him into this question of water supply and the proposed plan for extending it, and to "report for the information and guidance of the Legislature as to its practicability, cost," etc. This committee, accordingly appointed, was composed o fthe following gentlemen: Mayor Franklin Edson, Hon. O. B. Potter, John T. Agnew, William Dowd, Amos F. Eno, and Hugh N. Camp. They first requested from the Chief Engineer of the Croton aqueduct a report "in writing, on the amount and location of storage required in the Croton basin, for a daily supply of 150, 200, 250, and 300,000,000 gallons, and to append the opinion of the Consulting Engineer." In obedience to this request Chief Engineer Isaac Newton submitted a statement of the data required on February 21, 1883, and recommended the erection of a dam at Quaker Bridge, near the mouth of the Croton River, with a view to impounding all the available water from the Croton basin. The Consulting Engineers, referred to in the committee's resolution, were J. B. Jervis, E. S. Chesbrough, Jas. B. Francis, Geo. S. Greene, Julius W. Adams, and Robt. K. Martin; all of these experts unhesitatingly indorsed the Quaker Bridge plan "as the best, in fact the only, plan that can, consistently with the best interests of the city, be adopted for securing a large additional water supply from the Croton basin."

On March 7, 1883, the Citizens' Committee reported to the Legislature, and their recommendations may be summarized as follows:

1st. The present aqueduct can deliver no more than 95,000,000 to 98,000,000 gallons daily.

2d. A new aqueduct should be built immediately.

3d. The Croton watershed is the best source of supply to the extent of 250,000,000 gallons daily in a dry season.

4th. The aqueduct should, if possible, be in rock, and of a diameter of 15 ft. at least.

5th. Provision should be made for the ultimate storage of *all* the available water from the Croton basin.

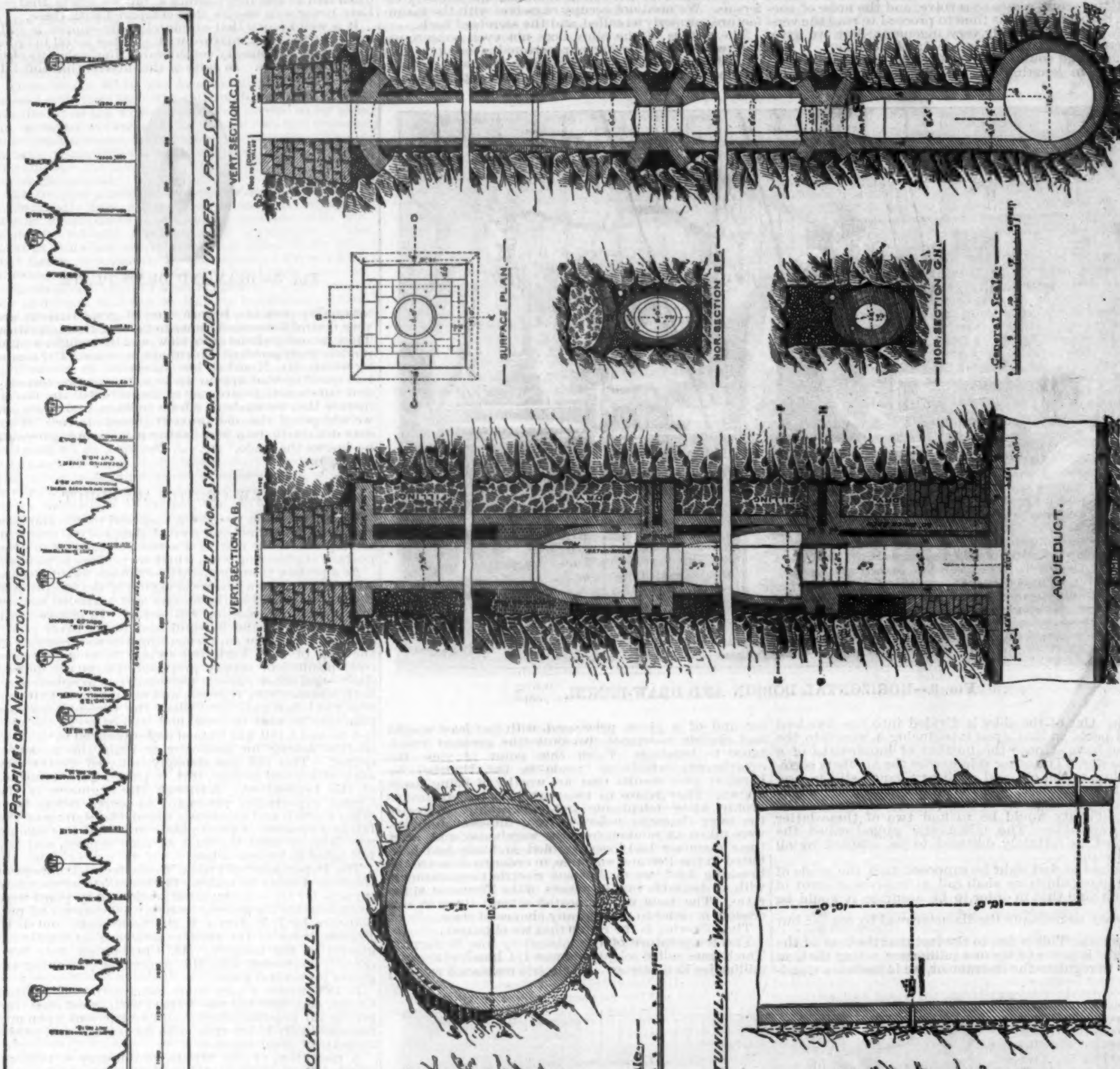
6th. Whether this storage, to the extent of 32,000,000,000 gallons, shall be effected by means of a dam at Quaker Bridge, to be supplemented if need be by an additional reservoir in the watershed above the present Croton dam, or whether reservoirs above the Croton dam shall be built from time to time as needed, was not determined by the committee; but they recommended that a commission be appointed to consider and decide upon this and kindred questions, and to control the entire work.

Works to prepare and present to the Commission, from time to time, all plans, specifications, etc., required, subject to acceptance, rejection, or modification by the Aqueduct Commission.

Owing to the absence in Europe of one of its members, the Commission was not formally organized until August 8, 1883, and very soon thereafter Benjamin S. Church long connected with the old Croton aqueduct, was appointed Chief Engineer to the Commission, and later, A. Fteley, late Chief Assistant City Engineer of

but also, as stated in their petition, to the "cutting up of the roads and traveled ways of the country, and the influx of laborers with the attending circumstances of drunkenness, noise, riot, and other evils."

To meet this really vigorous opposition, much time was expended in making new surveys and new plans, and the Commission abandoned the Quaker Bridge as a point of beginning for the new aqueduct, and determined to start directly from the Croton dam; the reasons given being that the latter point was prefer-



THE NEW CROTON AQUEDUCT.

The new aqueduct bill passed the Legislature on May 3, 1883, and was signed by the Governor on June 1; the work was to be conducted under a commission, named in the act as follows: the Mayor and Comptroller of the city of New York and the Commissioner of Public Works, together with George W. Lane, Jas. C. Spencer, and William Dowd. (Mr. Lane having died since the passage of this act, Mr. C. C. Baldwin was appointed, about Feb. 1, 1884, to succeed him upon the Commission.) The act itself is too long for insertion; the sections regulating the engineering control of the work make it the duty of the Commissioner of Public

Boston, was made Executive Engineer, and Joseph P. Davis, late City Engineer of Boston, the Consulting Engineer of the Aqueduct Commission.

It was supposed that active work would at once be commenced; but an element of delay, not anticipated, now presented itself with considerable force, and this was the opposition of the wealthy and influential landowners on the proposed route, which was by way of the North River directly to the Quaker Bridge dam. These parties not only objected to the running of a tunnel under their lands, though it was so far removed as to in no wise interfere with the surface embellishments,

able from a sanitary point of view, and that it was possible to thus increase the water supply of New York to a degree at least, without waiting for the completion of the Quaker Bridge dam; the Croton line was undoubtedly longer, but this additional length of aqueduct was considered as being outweighed by the other advantages mentioned. The first line surveyed on this new departure was common to the so-called North River line as far as Yonkers, when it took the Sawmill River valley, and following this finally reached the Croton dam by a rather circuitous route. This line, upon examination, was rejected as involving possible obstacles

to construction that would scarcely admit of estimation. A third line was now proposed, occupying the Sawmill River valley to a point east of Irvington, where it gradually approached the North River line and pointed toward the Quaker Bridge dam until near Tarrytown, where the direction again changed and the line ran straight to the Croton dam. This last is the adopted line. It is 8,381 ft. longer than the route commencing at the Quaker Bridge, its total length from Croton dam to the crossing of the Harlem River being 148,692 ft., a little less than thirty miles.

The plans of tunnel shown are general plans as exhibited to the contracting parties, and are subject to such minor modifications as the service may require. Throughout its length the aqueduct is equivalent in flowing capacity to a circle 14 ft. in diameter, and the various sections are arranged to accord with this typical section. As drawn, the plans show three styles of arch-backing, that is, solid brick, rubble stone masonry, or concrete; the nature of the ground passed through will determine which one is to be adopted in each case. A drain is to be cut below the floor of the excavation whenever, in the opinion of the engineer, special means are necessary for draining the tunnel during its construction for the proper protection of the masonry, and they are to be filled before the completion of the work. All masonry is to be laid in cement mortar, one part cement to two parts of clean sharp sand. American cement will be generally used, though Portland cement may be required at certain points. The concrete will be made of sound, broken stone, not exceeding 2 in. in diameter, and will be mixed with cement mortar, as above described, in the proportion of five parts of broken stone to one part of cement; for special cases a concrete of broken stone, 1 in. in diameter, and mixed three parts of stone to one of cement, may be used. The bricks will be of the best quality of hand-made, hard-burned bricks; they are to be laid radially, and with no joint exceeding ¼ in. either in face or arch work; the inside faces are to be pointed with neat cement.

The shafts are to be 17 ft. 6 in. by 8 ft. in the clear, with the longest dimension parallel with the axis of the tunnel. Where the aqueduct is under pressure, as in the sections illustrated; special provisions are made in the man-holes for guarding against this upward pressure, providing drain-valves for emptying the shaft, and air-pipes for the escape of air during the refilling of the tunnel. The details of this construction are sufficiently shown on the accompanying plans.

Returning to the profile, it will be seen that there are 24 shafts shown, ranging from about 50 ft. to 350 ft. in depth; the various blow-offs and waste weirs at the low points in the profile are indicated, as are also the portions of the aqueduct to be executed in open cut. For construction purposes the entire conduit will be divided into seven divisions, with an engineer and his corps over each division; Mr. H. S. Craven has been appointed Construction Engineer in general charge, and the permanent engineering organization is now being perfected.

The total area of the Croton watershed is 361·82 square miles, which will be entirely above the proposed dam at Quaker Bridge; there are only 338·82 square miles of watershed above the Croton dam. The Croton is a river with wide fluctuations in its discharge; its daily flow at the present dam varying from 10,000,000 to over 8,000,000,000 of gallons; this wide variation explains the necessity for the immense storage capacity required to secure an adequate daily supply to the city. The storage capacity afforded by the proposed Quaker Bridge dam is about 32,000,000,000 gallons, sufficient to insure a daily supply to the city of New York of 250,000,000 gallons available for distribution.—*Engineering News.*

THE NEW CROTON AQUEDUCT.—CONTRACTS FOR TWELVE MILLIONS.

THE Aqueduct Commissioners, on Dec. 13, 1884, awarded the contracts for all the sections of the new aqueduct. The awards made were as follows:

Section A—Heman Clark	$1,051,675
Section B—Heman Clark	1,096,065
Section 9—O'Brien & Clark..........	1,333,237
Section 8—O'Brien & Clark..........	1,157,285
Section 7—O'Brien & Clark..........	1,376,785
Section 6—O'Brien & Clark	578,140
Section 5—Brown, Howard & Co ...	726,975
Section 4—Brown, Howard & Co ..	1,518,475
Section 3—Brown, Howard & Co ...	1,398,050
Section 2—Brown, Howard & Co....	1,653,655
	$11,911,607

OVERWORK IN GERMAN SCHOOLS.

AFTER forty-two years' experience, it is now virtually conceded in Germany that physical exercise is not a sufficient antidote to brain pressure, but that, when the evil exists, the remedy must be sought in the removal of the cause. Official action with reference to overpressure has been taken in Prussia, Saxony, Wurtemberg, Baden, Hesse, and Alsace-Lorraine. The commission appointed by the Stadtholder of Alsace-Lorraine recommended that the number of study hours should be restricted to twenty-six a week for the lowest classes of the gymnasia, and to twenty-eight and thirty-two for the higher; that the hours of home study should be eight, twelve, and eighteen a week, progressing from the lowest class to the highest; and that six hours a week should be devoted to general physical exercise, including swimming, open air sports, skating, and excursions. While the existing conditions will be somewhat ameliorated by these decrees, they do not seem to have brought about a final solution of the difficulty. Last year a petition upon the subject, signed by eminent teachers, physicians, and other citizens, was addressed to the Prussian Chamber of Deputies. After setting forth the deplorable effects of the excessive strain upon the nervous system of scholars, it appeals to the patriotism of the deputies to put an end to the abuse, which, the petition asserts, "threatens little by little to reduce the cultivated classes of society to a state of moral weakness that shall render them incapable of great and manly resolution."

WHAT WE KNOW ABOUT CHOLERA.*

By FRANK H. HAMILTON, M.D.

1. WE have no positive knowledge of the existence of a specific cholera-germ.

While the existence of a specific cholera-germ, endowed with the principle of life and capable of growth and propagation when supplied with its proper nutriment, is rendered probable by many facts and analogies, yet such a supposition has not been established by strict scientific observation or reasoning.

I employ the term "cholera-germ," then, only as a substitute for "cholera-infecting material," whatever that may be, and as the term which most nearly expresses my belief as to its nature.

2. So long ago as 1854 or 1855, Professor Filippo Pacini, of Naples, published in the Italian *Medical Gazette* a paper on cholera, in which he describes a germ or microbe, and to whose presence he ascribed the epidemic cholera. His paper was translated into French and English, and republished in 1865, 1866, 1871, and 1879.

Koch has more recently (1883) discovered in the intestinal secretions of cholera patients a bacillus or spirillum, designated usually as the "comma" bacillus or spirillum, which, so far as his observations have extended, is uniformly present in well-defined examples of cholera, and is not found in any other conditions of disease or of health.

Dr H. Vandyke Carter, of Bombay,† has found an organism which it is conceded resembles very much the comma microbe of Koch. The presumption seems to be that it is the same, but of which microbe Dr. Carter says that it was not uniformly found in cases of cholera, and that it was occasionally present in cases of diarrhœa and dysentery.

Dr. Maurin and Dr. Lange, as the result of their studies at Marseilles, ‡ announce that they have discovered a mucor, which, in the process of its development, germinates spores, and these in turn germinate a new form of mucor, termed anaerobium; these latter, sporifying, give birth to the bacilli of Koch; and, finally, the bacilli develop the original mucor, and thus the cycle of life and development is completed. They regard the second form of mucor or anaerobium as the immediate cause of the phenomena of the disease, while they regard the bacilli of Koch as innocuous.

Dr. T. R. Lewis, of the British army, assistant professor of pathology in the army school at Netley, has been studying the cholera also at Marseilles, and he reports as the result of his investigations that the comma bacillus is present in all well-developed cases of Asiatic cholera, but that he has found it also in the salivary secretions of healthy persons.§

It is also stated as a fact, tending in some measure to corroborate the opinions of Koch, that two Swiss physicians, Ritsch and Nicati, experimenting at the Pharo Hospital, Marseilles, under instructions from the French Government, have caused the Asiatic cholera in rats, Guinea-pigs, and dogs, by injecting the dejections of cholera patients into the duodenum after trying the ductus choledochus, hoping in this way to prevent the action of the gastric secretions and the bile upon the bacilli.‖

Certainly such statements ought to be received with a great deal of hesitation. So far as I am informed, none of these animals has been known to take the cholera under ordinary exposures, and the Egyptian Commission was unable to produce it by inoculation or injection in cats, dogs, mice, rabbits, or hens.

Dogs are the almost universal companions of men in all countries, both in health and sickness, and their habit of eating all kinds of decaying and filthy substances, including human excreta, is well known, yet I have never seen a case of cholera among dogs, nor do I know that any one else has. That these animals should have had some sort of disturbance of the bowels, after the severe surgical operations to which they were subjected, is quite probable, but that this was of the nature of Asiatic cholera is not, in the light of our experience with dogs, at all probable.

A correspondent of the *New York Times*, in a cable dispatch, says that Dr. Klein, a Bombay official and expert, has experimented upon himself by swallowing a quantity of the comma bacilli, and without harm.¶

Professors Finkler and Prior, of Bonn, announce that they have discovered the comma bacillus in the stools of those suffering only with cholera nostras or cholera morbus.**

Straus, Roux, Rocard, and Thuillier, pursuing their investigations under the authority of the French Government in Egypt during the month of August, 1883, declare, for reasons which they assign, that they do not feel themselves justified in concluding that the comma bacillus of Koch is the cause of cholera.††

Finally, MM. Sicard, Taxier, Loucel, Livon, and Chareyre, members of a commission appointed by the French Academy, and who pursued their investigations at Marseilles, report that the blood of a cholera patient injected into the veins of a rabbit will cause cholera; the perspiration thus injected does not transmit the cholera; the intestinal contents, loaded with bacilli, do not transmit the cholera when injected into the cellular tissue of the peritonæum, into the windpipe, into the blood, or into the intestines; that the comma bacillus is not the cause of cholera; and they conclude by saying: "We know better than our predecessors what the cholera is not, but we do not know what it is."‡‡

We are at least permitted to say, in view of the conflicting testimony to which I have referred, and of many other statements made by less conspicuous observers, that the theory of Koch that the comma bacillus is the cause of cholera has not been established.

3. Even if it were established that the comma bacillus was always present in cholera and never present in any other condition of health or of disease, it would not determine the question whether this bacillus stood in the relation of cause or effect.

4. The theory is defective, also, in that it has not been shown that the ingestion or reception into the human system of excreta containing the comma bacillus will produce the cholera. On the contrary, if we can accept the current reports, there is at least the testimony of one experimenter that it will not.* The inoculations practiced by Koch himself were barren of results.

5. If the facts were demonstrated that the ingestion of choleraic discharges containing either of the microbes mentioned would cause cholera, the question would remain, which of the microbes hitherto described was the efficient agent, or whether any of them were, or indeed whether it was not some microbe for the discovery of which the microscope has not yet been invented; and, finally whether it is a germ of any kind, or only the fluids in which they are contained, and which have undergone some peculiar changes, for the detection of which no microscope hereafter constructed may prove sufficient. By successful inoculation of the germs alone, after they have been completely isolated by cultivation, could they be proved to be the cause of cholera, and this has not been done.

I do not wish to underestimate the importance of microscopic studies; nor can I always accept of the estimate which some seem disposed to place upon them. They have added greatly to our knowledge of disease, and give us encouraging promise for the future; but, so far as cholera and a majority, to say the least, of other epidemic and infectious diseases are concerned, they have not taught a single lesson either in the prevention or the cure. Their germicides kill the microbes when they are attacked outside of the body and removed from their native element, but they are harmless to them when the assault is made inside the human body; consequently, the unfortunate patients continue to die since the supposed discovery of the parasites the same as before.

It is not *positively* determined that the infecting material is not hereafter to be found in the blood or tissues of the body, in the breath, or in some other secretions than the intestinal. The experiments of the French Commission would at least seem to show that it is in the blood.

When, therefore, Koch places in contrast the results of microscopic investigations and the results of experience, declaring that the latter has not taught us the successful treatment of cholera, he permits the reader to draw an unfair inference. The contrast is not unfavorable to experience, inasmuch as it has taught us something, indeed, as will hereafter be shown, a great deal, in reference to the treatment of cholera, while microscopical studies have taught us absolutely nothing.

6. The cholera germ may be conveyed from place to place by clothing or any other textural fabrics, by articles of food, or by water, and by many other animate and inanimate substances.

7. It may be conveyed for considerable distances by the air. How far it can be thus conveyed it would be impossible to say, but probably much would depend upon the force of the wind and other atmospheric conditions. There is, no doubt, a limit to its conveyance by this method, and I have reasons to believe that it cannot be thus conveyed beyond a mile or two.

Those who have denied, or permitted themselves to doubt, that cholera can be thus conveyed have, it seems to me, either been inexperienced, or they have closed their eyes to the testimony which the experience of almost every epidemic supplies in such abundance.

8. The theory of Koch that the germ only finds its way into the system through the mouth and stomach is the necessary corollary to his belief that the comma bacillus is found only in the alimentary canal, and that it is the true germ or cause of the disease, and the only medium of its propagation; but it cannot be inferred from any facts observed by me in the histories of those epidemics in which I have had a personal experience, nor from anything I have seen recorded in my studies of this affection. That it may be one of the modes of propagation may be admitted, but that it is the sole or even the principal mode of propagation has no foundation other than Koch's unproved, and to me improbable, theory that the comma bacillus is the true germ of the cholera.

9. There is quite as much reason to believe that it is conveyed into the system by the respiratory organs, and that it diffuses itself thoughout the entire body through the circulatory system, like any other septic infection, and that the specific symptoms and the specific choleraic intestinal secretions are the results of a general systemic infection.

Why the poison expends its force in one direction or another, or why, perhaps, it seeks to eliminate itself through one organ of the body rather than another, cannot be explained any more than we can explain the preference of eruptive contagious maladies for elimination by the skin, and the preference of other septic infections for other organs and tissues. It certainly is not necessary to assume, because the intestinal secretions are changed and the intestinal mucous membrane is congested, that the virus was implanted originally in the intestinal canal. The blood, the perspiratory and the renal secretions, and the kidneys themselves, undergo changes quite as marked and distinctive as those which take place in the intestinal secretions and in the mucous membrane of the intestines.

10. It is probable that the cholera germ or virus, although it may have been received into the system, does not necessarily infect the system, or give rise to cholera.

It seems probable that every person living in, or even entering temporarily, a cholera atmosphere receives more or less of the virus into his system, but of those persons thus inoculated many do not suffer in any degree, and others only slightly, while a small proportion are taken sick and die.

It is true also of all other infectious diseases, that inoculation or the reception of the virus into the system does not necessarily produce the specific disease. Especially is this true of all eruptive infectious diseases. But in the case of most infectious diseases a large proportion of those exposed become infected, while in the case of cholera a very small proportion become infected. In other words, a suitable soil, or suitable conditions for the development of the germ, are usually found in the former, while in the latter they are seldom found.

We, of course, must except from this general statement, in regard to other infectious maladies than the

* Abstract from a paper read before N. Y. Academy of Medicine, Nov. 6, 1884.—*N. Y. Med. Journal.*

† *Med. Record*, September 27, 1884, p. 350. From the *Lancet* for September 6, 1884.

‡ *Med. Record*, September 27, 1884, p. 350.

§ *Med. Record*, October 4, 1884, p. 381; October 11, p. 416.

‖ *Lancet*, September 20, 1884, p. 504.

¶ *New York Times*, October 5, 1884.

** *Med. Record*, October 18, 1884, p. 431.

†† *Archives de physiologie*, 15 mai, 1884, p. 381.

‡‡ *Med. Record*, October 25, 1884, p. 467.

* The statement has been repeated more recently by the *Medical Record*, November 8, 1884, p. 523.

cholera, variola in case the patient has been protected by vaccination. Cholera differs also from many other infectious maladies in that one attack affords no protection against a second.

11. The conditions requisite to render the inoculation of cholera by the ordinary methods effective are all those conditions which cause, or coexist with, disturbance of the natural secretions of the alimentary canal, including fear and other depressing mental emotions; the presence in the bowels of undigested, fermented, putrefying, or of other acrid ingesta; deterioration of the air habitually inhaled, from personal filth, and from overcrowding in ill-ventilated apartments; inhalation of the air from putrefying masses of vegetable or animal matter, from stagnant pools of water, or from soils freshly exposed; and, finally, the concurrence of a warm and moist condition of the atmosphere.

Of all the conditions enumerated as favoring the germination of the cholera germ, none are probably so efficient as the inhalation of the vapors arising from a freshly exposed soil, especially if it contains decaying vegetable matter, and the concurrence of a humid state of the atmosphere with an elevated temperature.

The poor, both in cities and in the country, mostly occupy the lowest lands. If these lands are alluvial, and especially if underlain with clay so as to retain the moisture, they favor the propagation of cholera as well as of other diseases. The preference which most epidemics show for the habitations of the poor is therefore often susceptible of another explanation than that their personal habits are uncleanly, or that they suffer from overcrowding and bad ventilation.

In addition to the testimony furnished by the Suspension Bridge epidemic, as to the relations existing between low and alluvial soils and the propagation of the cholera, I could add a personal experience in Buffalo and New York, but especially in the former city, through several epidemics. In Buffalo a low and *sandy* plain, bordering upon the lake and wholly occupied by Irish shanties, was almost entirely exempt.

In the report of Mr. Farr, Registrar-General of England, for 1848–49, may be found a very full and complete statistical statement upon this subject; and after having taken into account, as contributory conditions, density of population, poverty, intemperance, uncleanliness, and many other causes, Mr. Farr concludes that the influence of a low and unwholesome soil was by far the most potent exciting cause. "It has been seen," he says, "how rapidly in London the cholera diminishes a few feet above the low ground on a level with the Thames."

This observation was not made for the first time by Mr. Farr. It is as old almost as the existence of the cholera. Exceptions have been noted from time to time, as, for example, in the frequent occurrence of the cholera at Bellary, in India, where an English fort is built upon a granite rock 500 feet high; but in this case, as probably in all other similar exceptional cases, a sufficient purely local cause can be found, and the exceptions do not affect the value of the general law which has been stated.

Need I remind you, gentlemen, of the terrible fatality of this scourage at Toledo and Sandusky, Ohio, in 1849, in the latter of which cities alone seventeen physicians died of the disease? Both of these towns are situated upon low and exceedingly rich alluvial plains.

As to the effect of a fresh exposure of an alluvial soil, or of soils more or less impregnated with decaying vegetable matter, permit me to refer briefly to an experience at Buffalo.

On Saturday, July 24, 1852, a ditch was commenced for the purpose of laying pipes through Ellicott Street, Buffalo. On Monday the work was renewed, and it was opened completely on Tuesday. The excavations brought to the surface a large amount of alluvium underlying made ground of clay and sand. The cholera was prevailing in a mild form in some other parts of the city; but Ellicott street had always been regarded as healthy, and had almost entirely escaped in previous epidemics. It was occupied by the best class of citizens. There were twenty residences upon the portion of this street corresponding with the ditch. On Monday the first case of cholera occurred among the residents, and on this and the two following days there were nineteen cases and nine deaths. The ditch was closed, by order of the Mayor, on Wednesday, and from this date there were no new cases.*

11. There has been as yet no specific discovered for the treatment of Asiatic cholera. Nor can we entertain much hope that there ever will be. Science has hitherto brought to our knowledge very few specifics for disease, and none has ever been found for any of the infectious epidemic diseases, and, considering the great number of medical men who have earnestly sought to discover a specific for cholera, and the infinite variety of medicines which have been employed, it would seem that there could remain but little ground of hope that it would ever be discovered.

We have learned from clinical experience, however, in the case of cholera, much more than we have learned in the case of any other infectious epidemic malady. We cannot terminate abruptly or abort the small-pox, measles, chicken-pox, or scarlatina. We can only control or modify them, so as to conduct them to safe terminations at their allotted periods. On the contrary, we can and do generally abort the cholera. A large majority of those who are treated by appropriate remedies, and especially if removed promptly from the influence of predisposing causes, recover quickly. To justify a denial of this, it will be necessary to assume that the diarrhœa which, in most cases, precedes the vomiting and collapse does not usually indicate the presence of the choloraic virus in the system—an assumption which implies that the cholera, unlike nearly all other diseases, has no admonitory prodromes. Such an assumption is unreasonable, and is not warranted by any facts of observation.

It is not often that a patient is saved to whom remedies are not applied until the algid period, or period of collapse, has arrived; but a large proportion are saved by appropriate remedies employed in the earlier stages of the disease. Dr. Yale, in the report on the cholera at Blackwell's Island, hereafter to be referred to, says that of those brought first to the "diarrhœa hospital," not one died.

* *Buffalo Med. Journal*, September 1852, p. 223. My report to the Buffalo Med. Assoc.

The means which have been most successfully employed are essentially those which have long been known to be successful in the treatment of diarrhœa, cholera morbus, and other allied affections. According to my observation, the remedies which have proved most efficient prior to the period of collapse are opium and absolute rest. Opium, in a solid form, should be preferred to morphine, as being less likely to provoke nausea. It should be given to adults, in doses of from half a grain to a grain, every three or four hours until the diarrhœa is restrained, or until *moderate* narcosis is produced. The production of excessive narcosis is seldom or never judicious, nor should the opiates, as a rule, be stopped suddenly, lest in either case nausea should ensue. Under no circumstances should the patient be permitted to rise, or even to occupy the sitting posture, after taking opium. If for any reason tincture of opium is preferred, it should be combined with tincture of ginger or some other diffusible stimulant. If morphine is used, it should be placed upon the tongue dry, and swallowed with not more than a teaspoonful of water.

As in ordinary diarrhœa, so also in the early stages of the diarrhœa of cholera, in case the stomach or bowels are known to contain highly irritating ingesta, a single brisk cathartic may be first given, and this to be followed, after a sufficient evacuation, by the opiate.

It is not intended to say that other medicines may not sometimes control the premonitory diarrhœa, but only that the writer has found the simple formula described the best.

If one should wish to render the theory of this treatment consistent with the theory of the existence of a cholera germ, it is only necessary to suppose, what seems probable, that the period of life, or of activity of the germ in the human system, is brief, and that the opium holds the secretions in a normal condition until the germ perishes or the force of its virus is expended.

There is much clinical experience which tends to show that in the human system the period of life or of activity of the germ is brief; and to this we may add one of the conclusions of the French Commission already referred to, namely, that "the blood of a choleraic patient, by cultivation, after a few hours loses its infectious properties."

We may also, I am persuaded, diminish the severity of an attack or arrest its progress by the prompt removal of the patient outside of those atmospheric, telluric, and other influences which are known to cause the development and propagation of the cholera.

12. Removal of an infected person to a perfectly healthy region—that is, a region supplying none of the conditions favorable to the development and propagation of the disease which has been named—does not in most cases cause a propagation of the disease in that region; but, like brands scattered abroad from burning buildings, provided they are not thrown among material already in a proper condition for combustion, they usually cause no further mischief.

LESSONS TAUGHT BY THE SUSPENSION BRIDGE EPIDEMIC.

The inferences to be drawn from the Suspension Bridge epidemic, so far as they have any bearing upon the opinions expressed in this paper, are confirmatory. They may be briefly stated as follows:

1. The cholera germ was brought by the emigrants who were temporarily detained near the settlement of laborers, the first case occurring among the emigrants. So far as can be learned, the emigrants had not suffered from the cholera before, nor did they after leaving Suspension Bridge. Upon this point our information is not positive and definite; but, at any rate, I feel justified in saying that the cholera, if it existed among them before or after their detention, was not in such a degree as to attract the attention of the railroad officials or of others; and this is all that it is necessary to establish for the purpose of my argument. It exhibited no virulence until it was communicated to the Suspension Bridge laborers.

2. That the emanations from a large amount of lately upturned soil, containing more or less decaying vegetable matter, contributed to the propagation and malignancy of the disease.

3. That the elevated temperature, together with the moisture of the atmosphere, constituted an important factor in the causation—a condition, however, which was not limited to this precise locality, although on these low lands bordering the river these conditions were most intense.

4. Dissemination of the infected, or of those persons who might be presumed or were known to carry with them the cholera-germ, did not propagate the disease—or at least in only a very few instances—to places where the topographical conditions were more favorable, and in these isolated examples no epidemics resulted.

WHAT HAVE WE TO APPREHEND IN CASE IT APPEARS AGAIN IN THIS CITY?

To the question which may appropriately be asked in this connection: In case the cholera reappears in this city, is there danger that it will prove as destructive as it has proved to be in the last epidemics at Naples, Toulon, Marseilles, and in some other towns of Southern France and Italy? I reply, No; and for the reasons that our climate is more favorable, our system of sewerage is better, there are no portions of the city which are relatively so low as to become the recipients of the drainage of the higher portions, we have a smaller proportion of very poor and personally unclean citizens, and, finally, because experience has shown that here, at least, the prompt application of judicious sanitary measures is certain to prevent the spread of the disease.

It would be an affectation of modesty on my part if I were to omit to refer, in confirmation of this statement, to the sudden and violent outbreak of cholera which occurred in the workhouse on Blackwell's Island, and to its speedy arrest under the application and enforcement of sanitary measures.

The cholera had appeared in great severity and malignancy at the workhouse, and was spreading rapidly over the Island. On the 1st day of August there were twenty-nine new cases and ten deaths at the workhouse. On the 2d there were thirty-three new cases and fourteen deaths. I was at that time chairman of the Committee of Inspection for the Islands, and on the morning of this day the Commissioners of Charities and Correction placed Blackwell's Island unreservedly under my control, so far as its sanitary condition was concerned. On the next day the most important sanitary changes had been made, some of which were very radical, and were in operation. At the close of this day there were reported thirty new cases and thirteen deaths; on the following day, August 4, there were twenty-one new cases and four deaths; on the 5th there were twelve new cases and seven deaths; on the 6th there were four new cases and three deaths; and on the 7th, one new case and one death. Thereafter, until September 23, a period of forty-six days, there were twenty-seven new cases, or considerably less than one a day, after which it ceased altogether.

Dr. Leroy M. Yale, who was at that time one of the fourteen house surgeons upon the Island, and who remained on duty to the close of the epidemic, made, by request of the Commissioners, a report upon the subject of the epidemic. This report, published subsequently by the Commissioners, is remarkable for the minuteness and accuracy of its statistical labor, and for the value of its many and carefully drawn conclusions. On the 7th day of August, the fourth day after the introduction of the most important sanitary changes, he reports, "the epidemic was virtually at an end."*

But this illustration of what may be accomplished, at least in our climate, is unimportant as compared with what has been done in this great city by the intelligent and energetic action of our Board of Health. Again and again the cholera has appeared in the lower parts of the city, and especially in our crowded tenement houses, and as often has it been confined to the narrowest limits or speedily "stamped out."

In concluding, gentlemen, I wish to repeat, what I have intimated before, that I know too well the value of the services which the students in microscopy have rendered to our difficult science to permit me to say one word which could in any way be construed into a lack of appreciation of their skillful, painstaking, and, in this country generally, unrequited labors, but, while we are hopefully waiting the disclosures of this important branch of our science, we must not neglect to give attention to the suggestions and demonstrations of clinical experience, especially when, as in the case of the Asiatic cholera, they have not been by any means barren of practical results.

* Annual Report of the Commissioners of Public Charities and Correction, 1866, p. xv; also pp. 109–197.

THE PHYLLOXERA, AND THE TREATMENT OF INFESTED VINES WITH SULPHIDE OF CARBON.

A STUDY of the phylloxera, that terrible insect which has nearly ruined a flourishing culture in several departments, and of its habits, of its mode of life, of its means of propagation, and of the processes capable of arresting or at least diminishing the ravages that it

FIG. 1.—DIBBLE INJECTOR.

causes, ought always to occupy the minds of those who are anxious about our national prosperity. In almost all the questions regarding agriculture, it is always necessary, it is true, to take into account the inertia and routine of small cultivators, who prefer to undergo considerable loss rather than change the least thing in the old methods that they are employing, or inform themselves concerning means that are capable of lessening such losses. Yet it seems that the ruin caused by the phylloxera is great enough to cause every one to try to resist the scourge as much as possible. A report published by Mr. Tisserand, Director of Agriculture, attests that out of 4,950,620 acres planted with grape vines before the scourge made its appearance in France, 1,718,794 were, on the first of October, 1883, entirely destroyed, and 1,284,726 invaded. It is important, then, to cut such devastation short, to protect the vines that have so far been preserved, and, in case it be desirable to preserve certain special races of French vines in regions that are already invaded, to prevent the action of the phylloxera by destroying it. The three principal processes that are recommended by the Phylloxera Commission for the destruction of the egg-layers that

affix themselves to the roots are submersion, sulpho-carbonates, and sulphide of carbon. Submersion, which drowns the insects, can hardly be employed, except in special localities, since we cannot always lead a sufficient quantity of water to the vineyard, to cover its entire surface, and to make up for the loss caused by evaporation during its stay thereon. As for sulpho-carbonates, the use of which was recommended by the illustrious chemist Dumas, their action amounts to the same as that exerted by sulphide of carbon, since, under the influence of the carbonic acid contained in the soil, they disengage all the sulphide of carbon that they contain. The use of them would be even more practical than that of the sulphide were they not dearer, did they not require a large amount of water to dissolve them, and did there not exist apparatus which permit of injecting into the earth without danger or previous practice definite quantities of sulphide of carbon. Thanks to the researches made at the instance of Mr. Paul Talabot, honorary director of the Paris-Lyons Mediterranean Company, by a committee consisting of Messrs. Magel, Gastine, and Cotta, and directed by Prof. Marion, agricultural technics is in possession of a very simple and easily performed method of insecticidal treatment through sulphide of carbon.

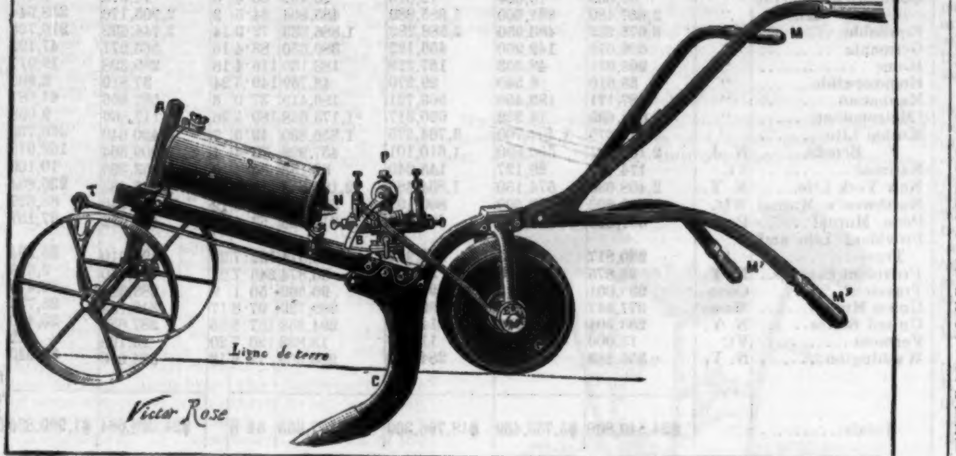
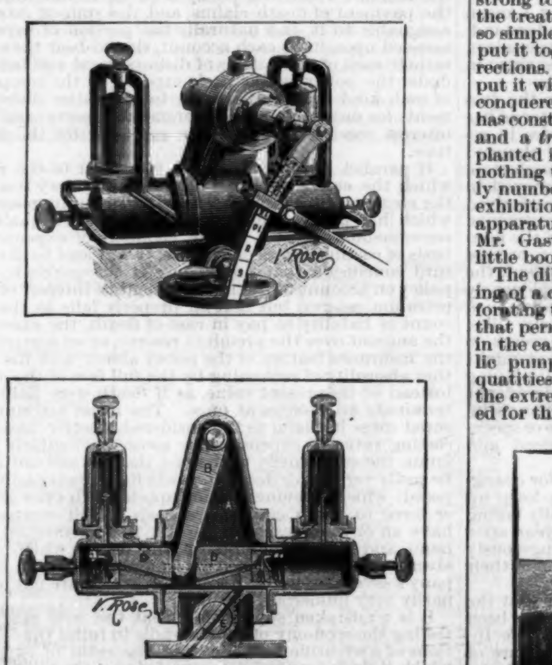


FIG. 2.—GASTINE'S TRACTION INJECTOR.

We may consider the soil as a porous body whose interstices contain air in permanent communication with the atmosphere, and which pours into the latter all the gases—carbonic acid and others—that are derived from the nutrition of plants or decomposition of organic matters. On another hand, sulphide of carbon is a colorless liquid heavier than water, and disengages vapors which, when mixed with even a small quantity of air, suffice to kill the phylloxera very quickly. Moreover, its evaporation is very rapid, and, as with ether, if we pour a few drops into the hollow of the hand, they quickly resolve themselves into vapor, and give a sensation of intense coldness. Therefore, if a certain quantity of the sulphide be introduced into the soil, it will immediately give off vapors that will be diffused, one after another, in the air that the soil contains, and all the insects found within its zone of action will be killed. This is the starting point of the method. There were, however, considerable difficulties to be overcome before it could enter into practice. Sulphide of carbon is a very inflammable body of disagreeable odor, and the vapor that it disengages forms a detonating mixture with air. If too large quantities of it are injected into the ground it may kill the rootlets, and consequently the vines; but if, on the contrary, the quantity be too small, the effect produced may be null or insufficient. It was necessary, besides, to invent an easily manipulated instrument that should permit of introducing definite doses of the sulphide to sufficient depths in the earth. Messrs. Marian and Gastine undertook to solve these difficulties, and we can boldly assert to-day that they have conquered them.



FIGS. 3 AND 4.—DETAILS OF THE PUMP.

It was also important to know how long the vapors of the sulphide should remain in the soil, and the extent of space that they covered from the point of injection. In principle, it may be granted that the sulphide diffuses itself more rapidly in permeable than in compact soils, that it spreads over a greater surface, and also that it flows more quickly in the atmosphere; but yet it was necessary to have accurate data. The researches made on this subject have shown that in grounds that have been tilled for some time, and that consequently have a high degree of permeability, we find scarcely a trace of sulphide twenty-four hours after injection. On the contrary, in sufficiently compact soil the vapors still remain for six or eight days after treatment, and their presence may be noted at more than three feet from the aperture of injection. On another hand, as these vapors are heavier than the air, they tend to descend into the soil, and their presence has at times been ascertained at a depth of over six feet below the surface. Under such circumstances, it will be readily conceived that by injecting given quantities of the sulphide into a vineyard, at distances learned by experience, the disengaged vapors will penetrate the entire soil to a sufficient depth to destroy the colonies of phylloxera that are affixed to the rootlets.

But one of the most difficult to do was to construct an injecting instrument. It was necessary, in fact, that such instrument should combine within itself a certain number of features that are difficult to associate, while at the same time it should be of sufficient delicacy to accurately gauge the quantity of sulphide to be injected. It was also necessary that it should be sufficiently strong to resist the shocks caused by the execution of the treatment itself, and that its mechanism should be so simple that the first comer could take it apart and put it together again after a few short and precise directions. Besides, its price had to be sufficiently low to put it within everybody's reach. Mr. G. Gastine has conquered these difficulties with rare ingenuity. He has constructed a *dibble injector* for ordinary treatment, and a *traction injector* for treating large vineyards planted in regular lines, and which in all respects leave nothing to be desired and have gained for him a goodly number of awards at agricultural and viticultural exhibitions. In order to explain the structure of these apparatus, we cannot do better than summarize what Mr. Gastine himself says about them in an excellent little book that all grape culturists ought to possess.

The dibble injector is a portable instrument consisting of a cylindrical reservoir that terminates in a perforating tube. Over the reservoir there are two handles that permit of grasping the dibble in order to insert it in the earth (Fig. 1). The reservoir contains a hydraulic pump designed for forcing accurately measured quatities of sulphide of carbon into the earth through the extremity of the perforating tube, which is provided for this purpose with a lateral aperture. The piston rod of this pump exceeds the reservoir in length. To operate the apparatus it is seized by the handles, the perforating tube is thrust into the ground by pressure both upon the handles and a pedal beneath the reservoir, and then the piston rod is shoved downward so as to force the sulphide through the extremity of the tube into the earth. When the pressure is removed from it the piston rod is forced upward through the action of an internal spring, and the instrument is thus primed for a new injection. Then the dibble is removed, and the aperture in the ground is closed with the foot or with a wooden bar having an iron head, and the same process is repeated for a new operation. The reservoir being previously filled with sulphide of carbon, the mechanism of the pump is so arranged that when the piston rises a definite quantity of the liquid enters the pump in order to be driven into the earth at the next operation, and so on. As the dibble is filled with sulphide, it is capable of serving for a large number of injections without the necessity of refilling it. As the quantity forced out depends upon the stroke of the piston, it is only necessary, in order to change the doses, to increase or diminish the length of the stroke by screwing special rings upon the rod.

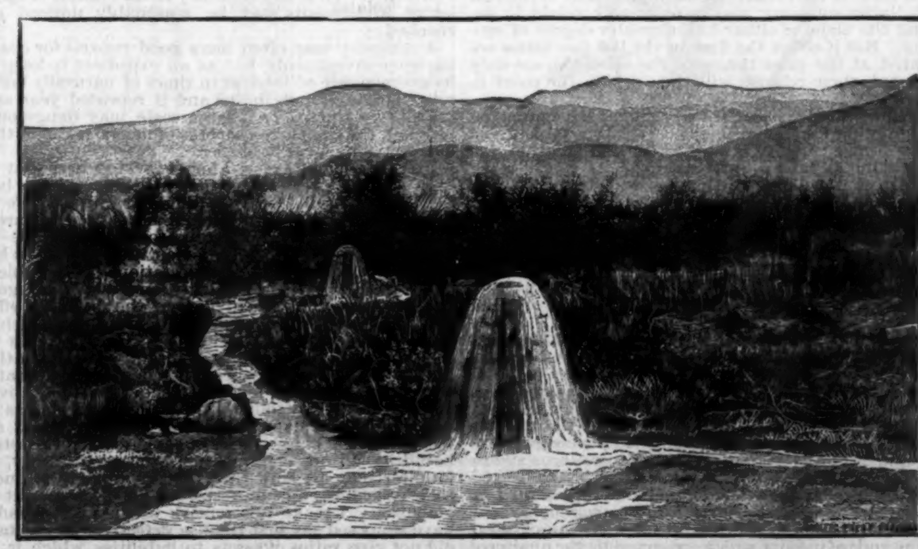
The traction injector (Fig. 2) is an assemblage of various peculiar pieces installed upon an apparatus similar to one of the plows used for light tilling. These pieces consist of a reservoir, R, placed upon the fore carriage of a colter, C, which is narrow and curved toward the front, and, finally, of a compressing roller, G, which closes the furrow made by the colter, and into which the sulphide has been forced. This roller also actuates the pump through the intermedium of an eccentric, E. An animal having been harnessed to the apparatus, the compressing roller revolves over the ground and sets in play the pump which is shown in detail in Figs. 3 and 4. At DD (Fig. 4) will be seen the piston, whose extremities contain small suction valves; B is a lever which moves the piston; A is the pump chamber; and E is the cock by means of which the entrance of the liquid into the apparatus may be cut off when it is desired to take it apart. The pump just described sucks the sulphide into the reservoir, measures the dose of it, and forces it, in *continuous injections*, into a groove back of the colter. The sulphide then enters the furrow made by the latter, and the compressing roller, in afterward passing, smooths the earth over the injected portion, and thus prevents all loss of vapor. This instrument is especially practical in that its motions are automatic, and that the circumstance alone of the traction exerted by the horse suffices to cause the entire apparatus to operate, without the driver having anything else to attend to than to keep the apparatus vertical by means of the upper handle, M. When the animal stops, all motion ceases, and the injection is interrupted. Moreover, these handles may be depressed and held by a bolt behind the frame, so that the driver can lift his apparatus and prevent the roller from bearing upon the earth.

It is positively to the facilities that these apparatus have furnished for the application of the method, as well as to the impulse given by a great railway company like that of Paris-Lyons-Mediterranean, which has at its disposal all the means of transportation, that must be attributed the rapid extension of the works undertaken since 1876, and their genuine success. A few figures will suffice to show the importance of these viticultural operations. Since the month of March, 1877, French manufacturers have delivered to viticulturists, for the treatment of phylloxerated vines, a little more than 26,400,000 pounds of sulphide of carbon. The principal works of Southern France have had to increase their production and erect additions. Manufacturing is now being carried on in the vicinity of the principal viticultural centers—at Marseilles, Narbonne, Bordeaux, and Lyons. Foreign countries have entered into the movement, and sulphide for anti-phylloxera treatment is being produced in Portugal, Italy, and Austria, and it is being employed in Spain, Germany, and Russia. It is permitted us to point with satisfaction to the success of this wholly French idea, which was emitted by Thenard and successively improved by Monestier, Allies, and the committee of the Paris-Lyons-Mediterranean Railway Company.—*La Nature.*

ARTESIAN WELLS AT POMONA, CAL.

No portion of the State has made such a rapid progress in the development of its natural resources as have Los Angeles and San Bernardino counties during the past few years.

In the fall of 1882, just two years ago, the Pomona Land and Water Company was incorporated for the purpose of developing and placing upon the market in small



ARTESIAN WELLS, POMONA, LOS ANGELES COUNTY, CAL.

tracts the virgin lands of this fertile valley. The company secured in its various purchases about 12,000 acres of land. The largest tract of about 2,700 acres embraced the small town of Pomona, then a place of about two hundred and fifty inhabitants.

The lands lie on each side of the Southern Pacific Railroad, a distance of seven miles, and slope imperceptibly south and west. The valley is shut in by an amphitheater of foothills and mountain slopes, forming a most charming landscape. Pomona is about seven hundred feet above the level of the ocean, which is some thirty miles distant. There are no violent winds; the sea breezes, tempered and robbed of their chills, reach Pomona about 10:30 o'clock, A.M., and blow pretty steadily until sundown the whole year. There is no oppressive heat at any season of the year, no heavy fogs at any time, and no desert winds that afflict other parts of Southern California. The valley has been justly termed "Nature's great sanitarium."

In no part of its operations has the company shown greater energy and reaped greater success than in the development of the water resources of the valley. The valleys and plains of Southern California are blessed with rich soil, but blessed indeed, twice blessed, is that land to which can be added abundance of water.

The sources of water supply which the company has developed are three in number, viz., San Antonio Canyon, cienega and artesian wells. The San Antonio Canyon extends into the Sierra Madre range of mountains to and surrounding the highest peaks of the range, which are covered with snow for at least eight months of the year, thus furnishing the stream flowing to the valley with a constant supply of water. Its watershed is one of the largest, being second only to the San Gabriel River, which, however, has not a similar advantage of the higher mountain peaks. A portion of the waters of this canyon are now owned by this company. Its volume during the winter and spring months is very great, more than sufficient to water all of the lands of the valley below.

During the summer months, however, the cultivation of all the lands below will require more water than it now furnishes. A portion of the waters of the canyon are now conducted by flume and cement pipe a distance of six miles from the Canyon-mouth to the company's lands below.

The company owns valuable cienega lands; one cienega is known as the largest in Southern California. The flow of water from these cienegas has been so steady and regular that no extensive work has been done to further develop the flow.

A great and important source of water supply has been the artesian wells.

The cut presented is an accurate illustration or photograph of two of the company's wells, of which there are twenty-five in various parts of the district. These two wells are about one hundred and seventy-three feet in depth, and have a flow of five inches, equal to 650,000 gallons, per day each. The various wells have been sunk to a depth of 100 and 200 feet, and give a flow of ½ inch and 8 inches according to locality. As to the permanence of these wells, it may be mentioned that two wells purchased with land have been constantly flowing for about ten years.

The company has developed a system of village water works for supplying the town with water for domestic use, and has extensive works for the manufacture of cement pipe.—*Resources of California.*

A NEW METHOD OF TESTING THE ECONOMY OF THE EXPENSES OF MANAGEMENT IN LIFE INSURANCE.

No. II.

IT was remarked in my treatise on this subject in SUPPLEMENT, No. 455, that when two particular companies are the subject of comparison as regards the economy of their expenses of management, and their respective ratios of insurance expense and net rates of interest earned have been found, it may still be necessary to equate either the rates of interest or the ratios of insurance expense, and note how this affects the relation of the duly corrected ratios on the other score, to decide exactly which has achieved, on the whole, the higher degree of economy during the period under observation.

Thus, in the table given in that treatise (which is repeated at the close of this for ready reference) it appeared that the ratio of insurance expense of the "Berkshire" company was 75·4 per cent., and its net rate of interest earned was 5·25 per cent.; and the same ratios of the "Northwestern Mutual" company were 78·8 and 5·80 per cent. As these ratios stand, it cannot be seen at a glance whether the lower insurance expense ratio of the former or the higher rate of interest of the latter company may have greater weight in deciding the claim of either to the greater degree of economy. But if either the first or the last two ratios are equated, at the same time that the other two are duly corrected, their relation will then decide the point in question.

To illustrate this process of equating, I have prepared the following table, which agrees with the table given in my former treatise, excepting the modification due to equating all rates of interest.

The reader will notice that I have selected 5·42 per cent., or the rate of interest earned by all the companies taken together, as the one to which to equate their several rates. It is not mathematically necessary to do this, though it is natural and convenient, because, as it does not alter the total footings of interest receipts, and expense on the score of insurance, it thus furnishes an obvious test of the accuracy with which the process of equating is performed.

This also makes it apparent that although alterations are made in the detail figures, they compensate each other, the interest receipts of each company being as much reduced as the insurance expenses are increased, or *vice versa*, and no injustice is done to any company by the process; while it serves to exhibit the relative economy of different companies by simple inspection of the figures in the *single column* of insurance expense ratios.

This is as simple an exhibit as can be presented on any of the erroneous bases hitherto employed, and although it is in a measure artificial, and cannot serve all the ends of inquiry which are served by the unaltered ratios of insurance expense and interest, and therefore should not be the only form of presenting the figures in

Table Exhibiting Ratios of Expense, Rates of Interest being equated, Determined by the New Mode, of Companies Doing Business in Massachusetts during the Year 1883.

Name of Company.	Location.	Death claims paid.	Estimated Premium. Reserve thereon.	Difference or Net Insurance furnished.	Expense on the score of Insurance.	Expense per $100 of claims paid. Rate.	Expense per $100 of claims paid. Rank.	Interest receipts.	Expense on the score of investment.	Net Rate of interest earned. Rate.	Net Rate of interest earned. Rank.
Berkshire	Mass.	$208,147	$46,605	$161,524	$127,702	79·1	15	$199,957	$15,809	All rates equated to 5·42 per cent.	All the same.
*John Hancock	"	169,604	25,117	144,487	234,331	162·1	25	141,171	11,686		
Mass. Mutual	"	426,995	86,215	340,780	192,660	56·5	10	888,515	33,176		
N. England Mutual.	"	1,039,694	235,630	804,064	170,292	21·2	1	854,595	69,906		
State Mutual	"	121,969	22,493	99,476	125,358	126·1	21	170,222	13,057		
Ætna	Conn.	1,302,807	364,510	938,297	249,195	26·6	3	1,550,165	118,962		
Connecticut General	"	87,639	15,624	72,015	25,492	35·4	5	74,978	5,407		
" Mutual.	"	2,867,489	881,600	1,985,889	485,864	24·5	2	2,905,176	238,944		
Equitable	N. Y.	3,072,232	483,950	2,588,282	1,886,333	72·9	14	2,744,632	216,725		
Germania	"	606,072	149,950	456,122	380,350	83·4	16	563,271	47,192		
Home	"	205,921	48,603	157,318	183,130	116·4	18	288,398	19,917		
Homœopathic	"	35,610	6,340	29,270	43,709	149·5	24	37,819	2,935		
Manhattan	"	667,171	163,450	503,721	186,419	37·0	6	587,866	44,081		
*Metropolitan	"	638,639	18,322	620,317	1,173,658	189·5	26	117,366	9,098		
Mutual Life	"	5,172,275	1,407,700	3,764,575	1,856,890	49·3	7	5,420,640	466,739		
" Benefit	N. J.	2,160,991	550,890	1,610,101	457,929	28·4	4	2,009,364	169,913		
National	Vt.	174,767	29,127	145,640	82,183	56·4	9	153,325	10,100		
New York Life	N. Y.	2,408,636	574,150	1,834,486	2,186,843	119·2	19	2,867,483	236,884		
Northwest'n Mutual	Wis.	990,692	190,500	800,192	558,420	69·8	12	1,127,840	88,527		
Penn. Mutual	Penn.	601,635	107,600	494,035	313,396	63 4	11	467,012	37,131		
Provident Life and Trust	"	280,817	49,865	230,952	306,574	132·7	22	423,910	33,294		
Provident Savings	N. Y.	24,875	1,828	23,047	56,874	246·7	27	10,160	2,579		
Travelers'	Conn.	235,001	42,243	192,758	96,569	50 1	8	283,626	22,476		
Union Mutual	Maine	377,547	88,520	289,027	282,729	97·8	17	346,184	28,754		
United States	N. Y.	283,304	69,245	214,059	294,353	137·5	23	287,850	23,460		
Vermont	Vt.	13,000	1,542	11,458	13,833	120·7	20	13,198	822		
Washington	N. Y.	356,289	71,820	284,469	206,509	72 6	13	364,016	32,249		
Totals		$24,549,808	$5,753,439	$18,796,369	$12,177,655	64·8		$24,398,684	$1,999,826	5·42	

Collective Business of Assessment Societies Doing Business in the State (excepting Secret Societies),

46 Societies	$735,382	$237,770	32·3

* Including industrial business.

any statistical exhibit, it may always be usefully given in connection with the former ratios.

I may observe here that the remark in my first treatise, that finding the net rate of interest earned is "equivalent to finding the ratio of investment expenses to interest receipts," was not, perhaps, sufficiently explicit. The soundness of that assertion depends on the principle that economy is *relative*, and a small investment expense is not economical if it fails to produce at least a proportionately large result, or as high net rate of interest, as a larger expense. A like remark, as was indicated in the following paragraph of that treatise, applies to insurance expense, only in this case the comparative economy of a given amount of expense is not proved if it does not accompany an accordingly low rate of mortality. Equating the ratios of insurance expense found both with reference to expected and actual death claims, in any two cases, as there said, decides this point.

Trusting that this brief explanation of what I mean by equating may remove one difficulty in understanding my first treatise experienced by some of its readers, I will make some further observations to assist them in perceiving the correctness of the new method.

It will be seen, by comparing the figures in the two tables now given, that equating the rates of interest has not greatly altered the rank of many companies in regard to insurance expense. Some have not changed rank at all, and others have changed only a single step, up or down; and were it not for the fact mentioned in my first treatise, that some of the companies derived considerable interest in 1883 from changing investments, or in other words by capitalizing the excess of the market over the cost value of some securities, a process which cannot be carried to an indefinite extent, the rank of no company would have been conspicuously changed. This shows that the rates of interest earned by careful companies must generally be nearly alike, and that the principal difference in economy occurs on the insurance score; but it may also show what might escape attention but for the new mode of displaying ratios, viz., whether any considerable or significant change is taking place at any time in a company's investments. Thus any tendency toward unsafe or speculative investments may be seasonably noticed and checked.

A company may often have good reasons for changing some investments, but as an expedient to keep up its average rate of interest in times of naturally falling rates, it has obvious limits; and if repeated year after year, or conducted on a large scale, may dangerously retrench the company's surplus of assets, taken at their market value, over liabilities.

I trust I may be excused for remarking here that the high rate of interest shown in my table to have been earned in 1883 by the New England Mutual Life Insurance company, with which I have the pleasure of being connected, is largely due to a special cause—recovery on an investment previously reckoned as loss; and that company has no expectation of being able to show so high a rate customarily, and does not regard, except as a temporary advantage, the favorable effect it has had on the company's standing in 1883, which, as seen by the company's insurance expense ratio in the original table, is sufficiently creditable before equating.

A company which is conducted with comparative economy in expense must also show a comparatively high ratio of assets to liabilities, or large surplus, as the result of its accumulation during any given period; and when any company's ratios of expense and of assets to liabilities do not confirm each other in this way, the inquirer may be sure that the discrepancy is due to some special circumstance susceptible of consistent explanation. I make this remark because some readers have supposed my first treatise defective, as the table did not give ratios of assets to liabilities, which it did not do simply because they are always now given by official reports, and by companies themselves, and are not pertinent to a discussion of economy of expense, except that, as just said, favorable ratios of assets to liabilities are the consequence thereof.

It has been truly remarked that any mode of displaying the economy of expenses of a company considered as a whole, which claims to be scientific, must answer the same end in reference to any individual policy. That this is true of the mode I am discussing is readily demonstrable.

Every single policy (according to its terms and present standing) bears a certain portion of the company's death claims in any year or given period, and on the other hand is similarly entitled to be credited with a certain portion of the interest earned by the company in the same time; and it is evident that the fairness or equity of whatever fraction of a company's expense is assessed upon any individual policy can only be intelligently measured by the magnitude of these two items, viz., the amount which the policy is liable to contribute to the payment of death claims and the sum of interest assignable to it; and naturally the portion of expense assessed upon it, on each account, should bear the same ratio to each of these items of disbursement and income under the policy as the whole expense of the company of each kind bears respectively to the entire disbursements for death claims (less premium reserve) and the interest receipts of the whole company for the same time.

If parallel reasoning is used in regard to the ratio which the entire expenses of a company may bear to the *mean amount* insured (excluding premium reserve), which has lately, and deservedly, received a qualified recommendation as a test of economy of expense, or basis of casting ratios of expense, it will lead to the absurd conclusion that no expense is chargeable to any policy on account of the improvement at interest of the premium reserve, but that all properly falls to the account of liability to pay in case of death, the excess of the amount over the premium reserve, or on account of the insurance feature of the policy alone; and the further absurdity of reckoning by the full face of the risk, instead of its present value, as if death were liable to terminate all policies at once. The mean amount insured owes its claim to be considered a better basis for casting ratios of expense than some (particularly premium income), chiefly to the fact that its amount may be easily verified, or deception as to its amount easily exposed; which recommendation applies with even greater force to death claims as a basis, which companies have an obvious reason not to care to overstate, on one hand, and interest receipts on the other, which may always be closely verified by examination of a company's several items of investment, which are not ordinarily very numerous.

It is a mistaken supposition that the new mode of testing the economy of expense fails to fulfill the conditions of a scientific test, because the ratio of expense which it finds for any company, for any single year or period, is only true for that year, and does not give certain evidence of what the same company's ratio may have been in preceding years, or may be in years to come, or of its average degree of economy. This is as incorrect as to call the thermometer an unscientific test of temperature, because it does not at once indicate present, past, and coming temperature. With the aid of continuous records, more can of course be learned than from a single record embracing only a short period of time.

Every new system of records must have its starting point. However, a single year's record goes far to indicate the average position in the order of economy of any *established company*, for variations due to exceptional and accidental circumstances always liable to occur in spite of good management, in such cases certainly are not likely to have very wide limits, or to speak figuratively, July days will not often occur in January, and wide divergencies therefore will commonly indicate permanent, rather than accidental and tran-

sient, causes of high or low ratios. As indicated in my first treatise, moreover, any old company can exhibit its past experience in the new form, in proof of the possibly exceptional character of its present ratios; or in the case of a very new company, or one practically so, a part of the expenses of which are not immediately borne by the policy holders, but are borne by the capital, and do not presently concern the policy holders, as in the case of the "Provident Savings" company in my list, this fact, and also the relation of the company's present ratio of expense to the ratios of older companies when in the same stages of their existence, may be cited in justification of any seeming extravagance.

In closing I may observe that the chief benefit to be derived from establishing a truly scientific and uniform system of computing ratios of economy of expense in life insurance is not so much the immediate use which particular exhibits of such ratios may be to individuals seeking insurance, as a means of deciding their choice wisely as to where to place it. Indeed, it is not desirable that all persons should be drawn to a single company, or to a few, which at the present may enjoy the very best standing, which would seem to be the logical tendency of this use of such exhibits; and hence it is fortunate that everything necessary for a true prognostication of the future cannot be learned at a glance, from the study of any single exhibit, however correct in composition, and that no such exhibit can wholly serve without explanations.

The chief benefit of such a system will be found, I think, rather in the uniformity of development and practice of all companies, which it will tend to bring about, by bringing their affairs, as far as they are of public concern, under better directed, more competent, and intelligent scrutiny. For the same reasons, it will render the possibility of doing business by false and specious representations more difficult.

It is my belief that the lack of such an established system, as a preventive, is one of the chief causes of past failures, and the extremes to which some companies have tended, including the disproportionate growth of some compared with others, to say the least, quite as intrinsically well managed.

The "co-operative," or "assessment," branch of life insurance business owes its origin, and perhaps its existence, largely to *protest* against alleged extremes of expense of management, which could hardly have occurred had such a system of testing economy been understood and in practice in the past. It is perhaps needless to say, that in these treatises of the question of economy of expense I have not before mentioned those minor and internal sources of revenue to a company, such as surrender charges, surplus uncalled for, and neglected claims, which of course serve to increase divisible surplus and lighten the burden of expense upon those members to whose account they do not fall; because, though these are necessary incidents of the business, they do not affect the question of economy, as they increase the cost of insurance of those members who suffer by them to exactly the same amount that they diminish that of those who do not. In other words, they do not affect the cost as a whole; and the perfect working of a company is measured rather by their smallness than their magnitude.

Again, and for like reasons, I have not mentioned that very fruitful source of internal revenue in the past practice of almost all companies, and the present practice of some, familiarly known as *forfeiture*. Whatever can be said in its defense, it is obvious that it cannot be admitted to directly affect or enter into the question of economy of expense, or the relation of the sole intrinsic and primary functions of life insurance *—paying death-claims, and improving assets at interest*—to the actual expenses incurred in accomplishing them.

Forfeiture is undeniably an *extrinsic* feature of life insurance practice, the magnitude and consequences of which, in justice to those companies which do not practice it, demands distinct exhibition and discussion; through which, if anything can be said in its favor, it certainly cannot suffer.

WALTER C. WRIGHT.

Medford, Mass., November 8, 1884.

POSTSCRIPT.—In addition to the amount of expenditure for 1883 set against the names of the several companies in the tables in this treatise, the commissioner reports the following sums under the head of "profit and loss," but as they are thus vaguely defined I have not incorporated them in the sums in the table, but leave the reader to judge for himself how much they might affect the ratios of the companies to which they pertain:

Berkshire, $8,655; Massachusetts Mutual, $44,104; State Mutual, $9,365; Connecticut Mutual, $183,277; Home, $71,292; Manhattan, $41,791; Mutual Life, $405,472; National $24,181; Northwestern Mutual, $12,248; Pennsylvania Mutual, $13,007; Provident Savings, $7,140; United States, $16,499; and Vermont, $2,100.

Table Exhibiting Ratios of Expense, Determined by the New Mode, of Companies Doing Business in Massachusetts during the Year 1883.

Name of Company.	Location.	Death claims paid.	Estimated Premium. Reserve thereon.	Difference or Net Insurance furnished.	Expense on the score of Insurance.	Expense per $100 of claims paid. Rate.	Rank.	Interest receipts.	Expense on the score of investment.	Net Rate of interest earned. Rate.	Rank.
Berkshire	Mass.	$208,147	$46,605	$161,524	$121,779	75·4	14	$194,067	$15,809	5·25	16
*John Hancock	"	169,604	25,117	144,487	†228,566	158·2	24	135,597	11,686	5·19	17
Mass. Mutual	"	426,995	86,215	340,780	232,400	68·2	10	428,255	33,176	6·08	7
N. England Mutual	"	1,039,694	235,630	804,064	311,879	38·8	3	995,883	69,908	6·40	4
State Mutual	"	121,969	22,493	99,476	98,839	99·4	19	143,751	13,057	4·51	25
Ætna	Conn.	1,302,807	364,510	938,297	460,014	49·0	6	1,760,872	118,962	6·22	5
Connecticut General	"	87,630	15,624	72,015	46,113	64·0	9	95,580	5,407	7·03	1
" Mutual	"	2,867,489	881,600	1,985,889	622,941	31·4	1	3,041,125	238,944	5·70	10
Equitable	N. Y.	3,072,232	483,950	2,588,282	1,884,108	72·8	12	2,743,024	216,725	5·42	12
Germania	"	606,072	149,950	456,122	325,662	71·4	11	508,702	47,193	4·85	23
Home	"	205,921	48,603	157,318	155,192	98·6	18	260,506	19,917	4·86	22
Homœopathic	"	35,610	6,340	29,270	48,734	166·5	25	42,814	2,935	6·20	6
Manhattan	"	687,171	183,450	503,721	226,305	44·9	5	627,628	44,081	5·82	8
*Metropolitan	"	638,639	18,322	620,317	1,161,803	187·3	26	106,916	9,098	4·90	21
Mutual Life	"	5,172,275	1,407,700	3,764,575	1,480,198	39·3	4	5,042,964	466,739	5·01	20
" Benefit	N. J.	2,160,991	550,890	1,610,101	521,829	32·4	2	2,072,629	169,913	5·61	11
National	Vt.	174,767	29,127	145,640	77,861	53·5	7	149,010	10,100	5·26	15
New York Life	N. Y.	2,408,636	574,150	1,834,486	1,995,102	108·8	21	2,676,592	236,884	5·03	19
Northwest'n Mutual	Wis.	990,693	190,500	800,193	630,583	78·8	15	1,200,001	88,527	5·80	9
Penn. Mutual	Penn.	601,625	107,600	494,025	309,858	63·7	8	463,567	37,131	5·38	13
Provident Life and Trust	"	280,817	49,865	230,952	222,665	96·4	17	340,115	33,294	4·26	26
Provident Savings	N. Y.	24,875	1,828	23,047	51,606	223·9	27	4,955	2,579	1·70	27
Travelers'	Conn.	235,001	42,243	192,758	144,621	75·0	13	331,623	22,476	6·42	3
Union Mutual	Maine	377,547	88,520	289,027	237,913	82·3	16	301,499	28,754	4·66	24
United States	N. Y.	283,304	69,245	214,059	277,919	129·8	23	271,594	23,460	5·09	18
Vermont	Vt.	13,000	1,542	11,458	13,613	118·8	22	12,917	822	5·33	14
Washington	N. Y.	356,289	71,830	284,469	289,461	101·8	20	446,998	32,249	6·78	2
Totals		$24,549,808	$5,753,439	$18,796,369	$12,177,655	64·8		$24,398,684	$1,999,826	5·42	
Collective Business of Assessment Societies Doing Business in the State (excepting Secret Societies).											
46 Societies		$735,383			$237,770	32·3					

* Including industrial business. † Includes $16,667 depreciation.

[THE GARDEN.]

CHRYSANTHEMUMS.

ONLY a few years ago this beautiful crown daisy was scarcely ever seen outside of botanic gardens, but at last, with the decidedly improved tone of later fashion,

CHRYSANTHEMUM CARINATUM.

it has become popular, and receives, to some extent, the attention which it so worthily merits. To my mind it was always beautiful, and before the daisy-like flowers became popular I used to think that this was one of the best of all plants for window boxes. Sometimes, of course, it is too tall, but where other window plants did not flourish I found this to do admirably. It seems to care little for drought or exposure. The accompanying plate faithfully represents the single white and pale yellow, and to my taste the single forms are much the most lovely. There are double forms of these, and they grow about 2½ feet high. C. coronarium nanum is comparatively a new strain, and it grows only about 1½ feet high, but I have not observed that any singles are offered. The colors are white and shades of yellow. It has been known as the African daisy and the garland chrysanthemum. Native of South Europe and North Africa. Introduced in 1629.

OTHER ANNUAL SPECIES.

C. carinatum (*C. tricolo*).—The tricolor chrysanthemum in many of its varieties is extremely beautiful, and ranks among the finest of hardy annuals. It has great variety in color, ranging from white to maroon-purple or crimson and yellow; and there are doubles of similar colors.

The strain known as Burridgeanum is very fine and

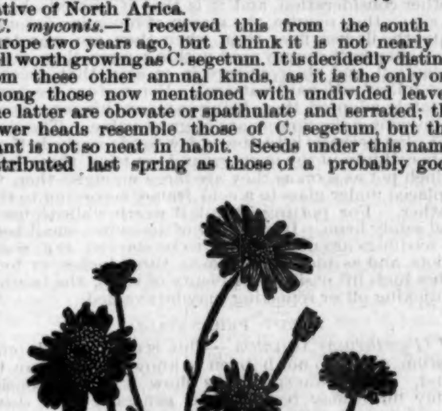
CHRYSANTHEMUM BURRIDGEANUM.

particularly handsome, and one of the forms is pure white, with a crimson circle round the disk.

Dunnett's strain includes fine doubles of white, purple, and yellow. Lord Beaconsfield, distributed a few years ago, in an improved form of venustum, with maroon rays. A good selection may be made from almost any seed catalogue, and all may be accepted as beautiful. This species may be distinguished from coronarium by the scales of the involucre, which are keeled, as the name denotes. It was introduced in 1796, and is a native of North Africa.

C. multicaule.—An annual, with apparently very beautiful yellow flowers. I have not grown it, but it is sometimes offered in seed catalogues, and as herbarium specimens promise so much from their appearance, I shall have it next year. It differs in habit from every other, the numerous branches, spread so immediately over the ground, taking their origin directly from the summit of the root. The leaves are finely divided, and the flower heads have a diameter of about 1½ inches. Native of North Africa.

C. myconis.—I received this from the south of Europe two years ago, but I think it is not nearly so well worth growing as C. segetum. It is decidedly distinct from these other annual kinds, as it is the only one among those now mentioned with undivided leaves. The latter are obovate or spathulate and serrated; the flower heads resemble those of C. segetum, but this plant is not so neat in habit. Seeds under this name, distributed last spring as those of a probably good



CHRYSANTHEMUM (PYRETHRUM) ROSEUM.

novelty, produced the next species. Native of South Europe and the Mediterranean region; introduced 1775.

C. segetum (*Corn Marigold*).—There are those who seem to doubt whether a British plant can be properly admitted into the garden, but there are many I know who would not like to be without this pretty plant, which I understand has even become a favorite in Covent Garden. Single specimens are somewhat stately, the glaucous laciniated leaves are handsome, and the

golden flower heads, nearly two inches across, are decidedly showy. I have a flower before me now, in the middle of November, and flowers are to be had whenever in winter the weather continues mild for a little while. Mr. Wolley Dod, I think, says this plant is more than annual; with us it seems strictly annual, but we have from self-sown seeds at all times plants in every stage. It is said not to be a true native of Britain. In England it is not very common, but in Scotland, where it is called Goulands, I have seen whole fields a sheet of color with it. The height is about one foot or one and a half feet, and it may be sown as C. coronarium, though generally, I think, young plants self-sown can be found for transplanting, and in moist weather it transplants very easily. Mr. R. S. Williams has distributed an improved strain as

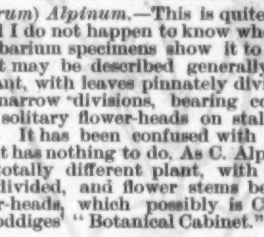
CHRYSANTHEMUM INODORUM PLENISSIMUM.

grandiflorum. Last spring I raised this from seeds distributed under the name C. myconis, which I consider decidedly inferior. Native of Europe, North Africa, and West Asia.

Culture of Annual Kinds.—All these sorts are most valuable for culture out of doors, though, perhaps, there are no annuals more easily grown in pots. The seeds should be sown out of doors in September, March, and May, but we always have a number of self-sown seedlings, and now there are nice little self-sown plants that will bloom in the spring. The summer brings the finest flowers, but we have them during a considerable part of the year, even in winter when the weather is mild. As annuals are so often left too thick, it is necessary to reiterate that to have fine plants thinning must be resorted to. These chrysanthemums are bushy in habit, and the natural habit is always the best, to be attained only by giving sufficient room. There is another consideration, and it is that if annuals have the space they require, the season of blooming is longer and the flowers finer than when they are crowded. These chrysanthemums need nothing more than good garden soil, and their culture is so easy that success must follow rational treatment. Pot culture we have not lately adopted, there being so many things to grow, but in winter the flowers are of great value. The simplest plan perhaps is to sow a few seeds early in September, thinly in the open ground, putting three in a six inch pot as soon as they are large enough, then to be placed under glass in a cold frame, according to the weather. For potting I think it worth while to use a good sandy loam. If sown out of doors in a small bed, the seedlings are not so likely to be starved as if sown in pots, and as nice little plants three inches or four inches high lift easily with plenty of roots, the trouble of pricking off or repotting may be avoided.

HARDY PERENNIALS.

C. (Pyrethrum) Alpinum.—This is quite rare in cultivation, and I do not happen to know where it can be found. Herbarium specimens show it to vary considerably, but it may be described generally as a small cæspitose plant, with leaves pinnately divided or pectinated into narrow divisions, bearing comparatively large, white, solitary flower-heads on stalks about six inches high. It has been confused with C. arcticum, with which it has nothing to do. As C. Alpinum I have received a totally different plant, with leaves more than once divided, and flower stems bearing about three flower-heads, which possibly is C. articum as figured in Loddiges' "Botanical Cabinet." It has been



CHRYSANTHEMUM FRUTESCENS.

called leucanthemum alpinum, but it is rightly, no doubt, placed under pyrethrum by De Candolle. Native of the Alps and Pyrenees.

C. (Leucanthemum) arcticum.—Under this name I speak of a plant sometimes grown as C. alpinum, with slender underground stems, which produce the shoots not in a tuft. The leaves are deeply divided and have about two lateral divisions like that of the center, each of them being again divided, though not so deeply, and the ultimate divisions are broad and toothed. The leaves are tufted on short woody stems; the flower stalk is stiff and erect, about eight inches high, bearing about three flowers. This plant, I think, is the C. arcticum of Loddiges' "Botanical Cabinet," but without a specimen in flower it is impossible to be certain. Mr. W. Dod sends it to me as C. arcticum or C. speciosum, so that the former name is somewhat confirmed. De Candolle describes a plant with solitary flower-heads, but with the figure above referred to, it is said that more are produced by cultivation. This figure shows an immense flower, head near 2½ inches across, such as I have never seen on this plant. It is not one of the best kinds. Native of Kamtschatka.

C. (Leucanthemum) atratum.—This is the Chrysan-

CHRYSANTHEMUM SINENSE.

themum atratum of Linnæus, and from specimens in the Cambridge herbarium it appears to be handsome in foliage. They seem to accord with De Candolle's description. The stem is erect and one-flowered; the leaves below are cuneate and divided into three or five large characteristic teeth, which are again dentate or serrated. It is not, however, this plant that is cultivated under the name, which, Mr. Wolley Dod in a recent letter informs me, is said by Sir Joseph Hooker to be certainly C. maximum. C. atratum was introduced in 1731, and is a native of Austria, Switzerland, and Auvergne.

C. (Pyrethrum) carneum.—A near ally of C. roseum, and the typical plants are so distinct that they should be kept apart, though probably a series of links might be found to connect the two. Both have very similar rosy flowers, but the habit of this is less robust than that of the other; the flowers are rather smaller and the leaves less finely divided. In this case the pinnæ are incised instead of being pinnate or pinnatisect. This is figured in the *Botanical Magazine* as Chrysanthemum coccineum. Native of the Caucasus.

C. Catananche.—The beauty of this plant is such that it must be mentioned, though, unfortunately, it is no longer in cultivation. It is one of the interesting

CHRYSANTHEMUM (PYRETHRUM) ULIGINOSUM.

novelties discovered by Sir Joseph Hooker, Messrs. Ball and Maw, when they visited Morocco some years ago. The root-stock divides into several heads, and the leaves, covered with a silky tomentum and divided into narrow segments, form a close silvery tuft. The flower stalks are from three inches to six inches long, and bear solitary heads one and a half inches or two inches across, the ray being pale yellow with a blood red ring around the central disk. Sir Joseph Hooker says that this is one of the most beautiful plants of the Greater Atlas. It grows in the valley of that range at an elevation of from 7,000 feet to 9,000 feet. Introduced in 1871. It flowers in April, and a good figure of it will be found in the *Botanical Magazine*, 1874, t. 6,107. The specific name was given on account of the silvery white involucral bracts, which resemble those of the genus Catananche. Although hardy it may perish from damp, and therefore when reobtained it must not be trusted entirely out of doors.

C. (Pyrethrum) cinerariæfolium.—This is a pretty plant found in botanic gardens, but not often in private collections. The leaves are graceful, glabrous above, below silky, and pinnately divided into narrow and rather distant segments; the white rayed flower-heads

CHRYSANTHEMUM (PYRETHRUM) ROSEUM (DOUBLE).

are produced singly on slender stalks, which much exceed the leaves, and measure about one and a half inches across. It was figured in the *Botanical Magazine* of October of last year, and it is stated that the Dalmatian insect powder is from the flowers of this plant, a fact not known until comparatively recently. Introduced 1826. Native of Dalmatia.

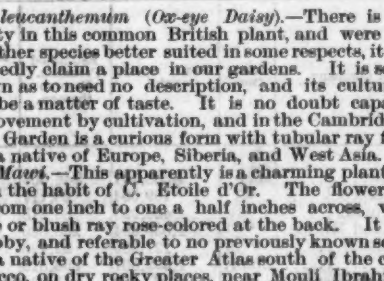
C. (Pyrethrum) corymbosum.—A distinct kind, about four feet high when in flower, with leaves somewhat similar to those of P. roseum, and broad corymbs of white rayed flower-heads about one and a quarter inches across. It is perfectly hardy and deserves to be better known, though under certain circumstances it becomes coarse. If it could be crossed with P. roseum the result might be good, and a distinct race, with stems bearing many heads like those of P. roseum might be produced.

C. INODORUM, HORT.=MATRICARIA INODORA.

C. (Leucanthemum) latifolium var. lacustre.—I am not sure that the form ranked as typical is in cultivation, but this variety, correctly determined at Kew, must now be common, as I myself distributed in exchange immense quantities when this kind of flower became popular. It is a very handsome and strong growing plant, in the Cambridge soil about three feet high, forming a close arrangement of strong erect stems, with coriaceous, oval, strongly serrated leaves. The stems branch sparingly at the top before flowering, and the only other similar kind which does this is C. maximum, which is distinguished by having the stem leaves about five times as long as broad, instead of about three times as long as broad, as in this case. This I notice from scraps before me, and the difference in foliage is very evident. The present is one of the best kinds; it is very ornamental in autumn, and the flowers are valuable for cutting. They are of good substance, and possess great beauty. Native of Portugal.

C. leucanthemum (Ox-eye Daisy).—There is much beauty in this common British plant, and were there not other species better suited in some respects, it would decidedly claim a place in our gardens. It is so well known as to need no description, and its culture can only be a matter of taste. It is no doubt capable of improvement by cultivation, and in the Cambridge Botanic Garden is a curious form with tubular ray florets. It is a native of Europe, Siberia, and West Asia.

C. Mawi.—This apparently is a charming plant, with much the habit of C. Etoile d'Or. The flower-heads are from one inch to one a half inches across, with a white or blush ray rose-colored at the back. It is half shrubby, and referable to no previously known section. It is a native of the Greater Atlas south of the city of Morocco, on dry rocky places, near Mouli Ibrahim, at 4,000 feet to 5,000 feet elevation, in the Reraia Valley. Most probably it has been lost to cultivation. It should not be intrusted entirely out of doors. It is figured in the *Botanical Magazine*, t. 5,997.



CHRYSANTHEMUM TCHIHATCHEWII.

C. (Leucanthemum) maximum.—Speaking of this as C. atratum, Mr. Wolley Dod has described it as the best garden form of the genus. He says, "It begins to flower early in July, and bears flowers four and a half inches across, while the plant, even in my strong wet soil, is no more than two feet high." Mr. Ware supplies a plant under this name, and as I know he has the true C. lacustre, it is probably this of which he speaks when

he says that it is as showy in autumn as the Japan anemone. It is allied to C. lacustre, with which it has been confounded, but the great difference in foliage makes it conspicuously different. In this plant the leaves are narrowly lanceolate, but in the case of C. lacustre they are nearly oval. As before remarked, the

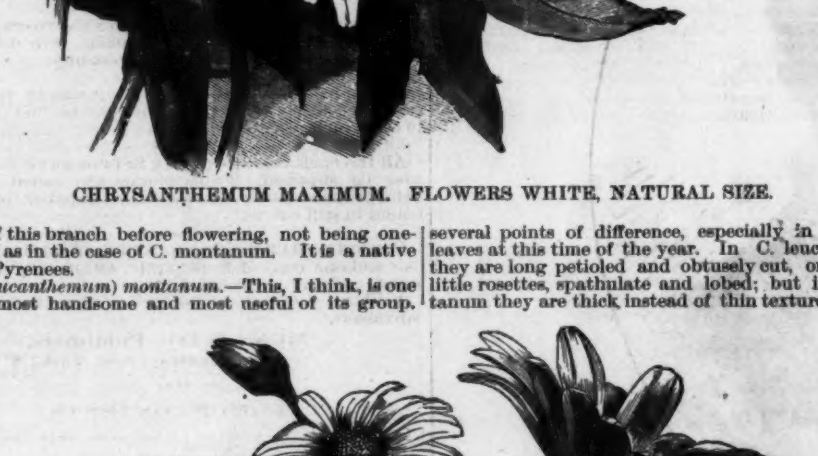
It is much less coarse than the popular C. latifolium lacustre, and it has a better habit than the Ox-eye daisy. It also has larger flowers, and it forms a rounder and better furnished tuft than almost any other. In our soil it is about eighteen inches high. It has been thought to resemble C. leucanthemum, but there are

CHRYSANTHEMUM MAXIMUM. FLOWERS WHITE, NATURAL SIZE.

stems of this branch before flowering, not being one-headed, as in the case of C. montanum. It is a native of the Pyrenees.

C. (Leucanthemum) montanum.—This, I think, is one of the most handsome and most useful of its group.

several points of difference, especially in the lower leaves at this time of the year. In C. leucanthemum they are long petioled and obtusely cut, or they form little rosettes, spathulate and lobed; but in C. montanum they are thick instead of thin textured, lanceo-



CHRYSANTHEMUM FRUTESCENS ETOILE D'OR. FLOWERS PALE YELLOW.

late, and serrated. It is earlier than similar kinds, except C. maximum, flowering in July. The stems grow erect and bear one flower head, each more than two and a half inches across. The leaves decrease in length to about the middle of the stem, where the latter becomes naked. Native of the south of Europe.

C. (Pyrethrum) Parthenium.—The golden-leaved variety of this is the golden feather, so well known to all gardeners. The normal plant is wild in Britain. It is scarcely worth cultivation, though some have much admired the golden feather when in flower. There is a double variety, which certainly is not common, if, indeed, it is cultivated anywhere. There are new varieties of golden feather which delight lovers of bedding out, especially aureum selaginoides, which does not flower the first year, and consequently does not require pinching. Native of Middle and South Europe.

C. (Pyrethrum) roseum.—Of this species we have now many splendid varieties from the hands of the florist known as the double flowered Pyrethrums, and to such perfection have they been brought within comparatively a few years that they rival the Aster and Chinese chrysanthemum. The first improvement, a single rose variety, came from M. Themisterri, of Belgium, into the hands of the late Mr. John Salter, of Hammersmith, and he gradually produced the double forms. The Continental florists also have produced some of the finest doubles we have. In one catalogue alone over 100 double varieties, as well as single ones, are offered. The single kinds have great variety in color, and are more lovely and graceful for vases than the heavier double varieties. Both sections are offered by the leading nurserymen, and a selection is easily made from their catalogues. Good single kinds may be obtained from a packet of seed, and we have had a very good result from the selection offered as atrosanguineum. As a garden plant the typical P. roseum, being comparatively poor in color, need not be grown. These showy plants require some care in cultivation in order to produce the most satisfactory results. They will not succeed in poor soil. A good loam is best, and it requires to be well manured. Dry soils should be mulched with manure, in order to keep the ground moist and cool. Cultivation in this way is very easy, and the plant is perfectly hardy. The flowers are very showy, and the finest display comes in June, though flowers are produced more or less throughout the summer, and if the plants are cut down after the first flowering they flower again in autumn. In November we have now some single flowers. Propagation is effected easily by division, and when the flowers, by getting small, show it to be necessary, the clumps must be taken up and divided, as the finest flowers are produced by tufts of moderate size. Native of the Caucasus.

C. (Pyrethrum) sinense (Chinese Chrysanthemum).—This is the well-known florist's flower now so valuable and important. Probably the wild original has never been introduced, but it may exist, and it would be of great interest to obtain it for botanic gardens. The few single varieties we have are no doubt very different, having been obtained from the so-called double kinds. I have grown a few this year, and some of them are very pretty, but they do not take the place of the double kinds as ornamental flowers. Much more may be done by raising and selection, and probably much better ones will be forthcoming. It is unnecessary to say anything here about the numerous cultivated improved forms which are so frequently treated of in this and other journals, and every Chrysanthemum grower can now have collected information in the valuable work by Mr. F. W. Burbidge quite recently published.

C. (Leucanthemum) speciosum.—Under this name is cultivated a hardy perennial about 1 foot in height, with large white flowers, but it is said not to be one of the best. The name, I believe, is undoubtedly wrong, and I can only find it as a synonym of C. coronarium or C. grandiflorum. Mr. Ware kindly sends me flowers, and it is neither of those; it is most like C. montanum, but appears to differ from it, and with the material now to be had it is impossible to find the name.

C. (Pyrethrum) tanacetoides.—A pretty silvery-leaved plant, of which there are old clumps in the Cambridge Botanic Garden. I have not known it elsewhere, nor has it been known to those who have seen it here. It is very distinct and attractive in foliage, but it does not flower. The stems are short and woody; the leaves are 4 inches to 6 inches long, and half an inch to 1 inch broad, covered with silky tomentum, twice pinnate, the pinnæ pectinate. The main leaf-stalk lasts in autumn long after the leaf is dead. I am indebted to Mr. N. E. Brown for this probably correct name.

C. (Pyrethrum) Tanacetum.—This by no means deserves attention as a flower garden plant. It is better known as Balsamita vulgaris or Pyrethrum Tanacetum. Some interest, however, attaches to it as being the Costmary or Alecost formerly put into ale. Two forms flowering at different times used to be in cultivation at Kew. Native of South Europe.

C. (Pyrethrum) Tchihatchewii.—A place for this may be found in most gardens. It is a creeping plant with pretty foliage and good white flowers, like those of the Ox-eye Daisy, very suitable for dry banks, where most herbaceous plants would fail to succeed. The stems root as they grow, and quickly produce a carpet of bright green foliage. The leaves are 1½ inches long and much divided. It has not been used as a bedding-out plant probably, but it appears to be very suitable for certain arrangements. Native of Central Asia, whence it was introduced in 1869.

C. (Pyrethrum) uliginosum=P. serotinum (Hort.).—This is the handsomest of all the cultivated kinds, if we omit the forms of C. sinense and C. roseum, as improved by the florists, and it deservedly ranks as one of the best herbaceous plants. It grows from four feet to six feet high, and is worthy of a conspicuous position. The leaves are lanceolate with pointed teeth directed forward, and the foliage is decidedly pretty. At this time of the year there are no leaves at the base of the plant, as in most other species, and it is very different from any other we grow. The flowers are of great size, and of very pure white. The stems do not branch below, but toward the summit they are divided into many slender stems, each bearing a solitary flower. The habit of the plant is very stately. It is sometimes, though erroneously, known as P. serotinum. It prefers a moist position, and decidedly likes good soil. In poor and dry soil it sometimes scarcely exceeds a foot in height. Under favorable circumstances it grows

with great vigor, and almost becomes a weed. Native of Hungary.

C. (*Pyrethrum*) *Willemoti.*—I have a plant from Mr. Wolley Dod under this name, but I can find the name in no book nor with specimens to which I have access. The character of the leaf is in some degree like that of C. cinerariæfolium, but the divisions of the pinnæ are very much broader. I have, I believe, under this name known a sub-shrubby kind, with finely cut leaves and good yellow flowers, which was not a good perennial or not quite hardy.

Culture of the Perennial Sorts.—The herbaceous species, without exception, grow best in rich soil. Some do not need manure, but others, if the soil is not good, cannot succeed without it. C. roseum generally needs manure, and C. uliginosum may often be very much benefited by it as regards appearance. In the dry and rather poor soil of the Cambridge Botanic Garden it scarcely exceeds a foot in height without special preparation for it, and C. roseum is altogether unworthy of its capabilities. Surely it is impossible to discuss the question whether manure is or is not required for herbaceous plants, without overlooking the immense variety included within that term, to say nothing about the different kinds of soil, often poor and indifferent, in which they are grown. I know they often want manure badly enough. With regard to these plants, the necessity of manuring must be considered from observation on the spot, because in some gardens they grow as strongly as could be desired. When the clumps get large, all kinds are benefited by division. They are easily propagated by division, and are generally very easy to grow. C. arcticum is the only one I have found not to do well, and that has been evidently from its dry position.

FRUTICOSE AND TENDER SPECIES.

C. (*Argyranthemum*) *Broussoneti.*—This appears to be the correct name of the plant grown as Halleri maximum, though flowering specimens have not yet been compared. With C. Halleri it has nothing to do. It is decidedly one of the two best frutescent species. The foliage is very handsome, and the flowers large and freely produced. The leaves are broadly obovate, green, divided into about six segments, which are again laciniated and toothed. Native of the Canaries; introduced in 1817.

C. fœniculaceum.—This is a very pretty plant, with glaucous leaves cut into slender divisions. They are glaucous, like those of C. frutescens, but much more graceful. The flowers are white and pretty. Native of the Canaries.

C. frutescens (*Paris Daisy or Marguerite*).—Better called the Paris Daisy or Marguerite than simply Marguerite, because that word means daisy, to express which the French have no other, and this plant is strongly associated with Paris, where it was a favorite years ago, when even it was scarcely known in Britain. The French call the daisy Marguerite on account of its pearly whiteness, Marguerite being the French for a pearl, though not now or but rarely so used. It is supposed generally that the name came from direct association with St. Margaret, and I mention this, therefore, on the authority of Dr. Brewster. During the last few years the Paris daisy has been in favor with us, but even yet it is not so popular as it ought to be, for it is so easily grown that good plants might be sold at a cheap rate for the million. Knowing the nature of it, no cultivator would fail to grow excellent specimens of any size he saw fit. An immense specimen of it, a white elephant in size, but more than that in usefulness, is rather an imposing object, especially in terrace vases or on grass. Small specimens, too, are valuable for the conservatory, where they flower freely in winter; indeed, it is easy to have it in flower all the year round. Another use for it is found in the flower garden, where with seedling petunias it makes one of the best beds. This is one of the best mixtures, and such are a great relief in place of masses of scarlet geraniums. In the greenhouse at this time of the year it associates agreeably with salvias, such as S. splendens and S. Hoveyi. No plant can better withstand extremes of damp and drought than this. In small pots it flowers better than in large ones, because the growth is restricted and a greater number of flowers is the result. Plants may be taken up from the open ground for flowering in winter, but I prefer to grow them in pots, and pinch to postpone flowering until the right time. When the cuttings should be struck depends upon the intended size of the plant, but cuttings struck in May grow to a very useful size. Native of the Canaries. It is a curious fact that insular floras often represent the continental herbaceous species by shrubby allies, and these Argyranthemums are cases in point. Introduced in 1699.

C. frutescens var. Etoile d'Or.—I mention this with C. frutescens, as it is so generally regarded as a variety of it, but I think that it is more or less a mistake, because although C. frutescens is shown by specimens to vary much, yet it does not, so far as I can discover, vary in the direction of Etoile d'Or, which seems to me to have some relationship with another species. In the Cambridge herbarium I find a specimen of C. ochroleucum, and if it were a hybrid with this, so far as my consideration goes, I should not be surprised. I shall endeavor to settle this question as soon as I have a specimen in flower. C. Etoile d'Or was distributed a few years ago by Mr. Howard, of Southgate, but no doubt it had been in cultivation some time before. The evidence with regard to its origin is conflicting. In the *Revue Horticole* it is stated to have been raised from C. frutescens near Lyons or near Cannes. In the *Gardeners' Chronicle* of March 6, 1880, "S. E. F." writes that it was raised about the year 1874 by Nicholas Desgeorges gardener at the Villa des Bruyères, at Golfe Juan, near Cannes, from seed gathered from Comtesse de Chambord, another similar kind. In this there is much probability, but then what is the origin of this last named form? Finally, M. Ed. Morren writes in the *Belgique Horticole* that it was brought to notice so long ago as 1844 by M. Pepin in the same journal, and that it was raised in the south of France from seed of the common white C. frutescens. That is perhaps possible, but, as I have said, it does not seem to me probable without the assistance of another species. Whatever its origin, however, it is certainly a valuable kind, and one of the best of this section. Its cultivation is the same as that for C. frutescens, except that it requires, I think, more liberal treatment. With treatment in small pots and confinement under which C. frutescens has flourished, I have found the flowers smaller than they should be. This I believe may be considered to supersede the variety Comtesse de Chambord, which I have not grown. It was cultivated ten years ago at Ferrieres.

C. pinnatifidum.—Not unlike C. Broussoneti, but the primary divisions of the leaf are not so deeply divided. The leaves are three or four times as long as broad, pinnati-lobate or pinnatifid, with from six to eight lobes or pinnæ. The flowers have a golden yellow disk and a white ray. A good greenhouse plant, but not so useful as C. frutescens nor so fine as C. Broussoneti. Native of Madeira.

Remarks.—All Chrysanthemums appear to vary very much, and, as will have been seen, the names of some kinds are doubtful. Throughout the genus figures and illustrations are much wanted. There are many curious species which might be introduced, but there are none perhaps so fine in their several groups as those we have already in cultivation, except probably C. (Argyranthemum) hæmatoma, of which Mr. Lowe says that in the island of Madeira "a bush of this species on its native black or gray and barren crags—one mass of lovely rose-pink flowers, and conspicuous from afar like a camelia or rose bush—is a truly splendid and surprising sight." I shall be extremely glad to receive doubtful kinds, or any not here mentioned, for cultivation, comparison, and identification. It is the Leucanthemum section which at present shows difficulty, and gradations though all the species might perhaps be found in a wild state. R. IRWIN LYNCH.

Botanic Garden, Cambridge.

THE VIOLINIST ARMA SENKRAH.

ARMA SENKRAH.

A GREAT change is taking place among the lady artists, as many of them are gradually leaving the piano and taking up the violin. Teresina Tua, the Italian lady violinist, first appeared in public a few years ago, when she created a grand sensation, and it is natural that others should attempt to follow the same course. Last winter a young American lady, Arma Senkrah, made her debut as a violin virtuoso, and was decidedly successful. Miss Senkrah is a pupil of Massard, of Paris, who was also the instructor of Teresina Tua and other celebrated virtuosos. The young lady, whose real name is Harkness, the reverse of her stage name, is at present twenty years old, and notwithstanding her youth has a worldwide reputation. The tones which she produces are not very great and powerful, but melodious, sweet, and fluent, which is to an extent due to the influence of her Paris master. Her *technique* is perfectly wonderful. There is much resemblance between Miss Senkrah and her Italian rival Miss Tua; both are young, beautiful, and master their instruments perfectly. Miss Tua is more lively, genial, and sprightly in her rendering, whereas the rendering of the American lady, Miss Harkness, is more elegant and quiet. Both ladies involuntarily remind one of the greatest lady violinists that have ever been heard, the Milanollo sisters and Miss Normann-Neruda, whose performances on the violin were equal to the very best.

The annexed portrait of Miss Senkrah (Harkness) was taken from the *Illustrirte Zeitung.*

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